Understanding GEM's Potential Beneficiaries:
A Study of Earthquake Risk Reduction Activities, Needs, and Barriers

GeoHazards International

Working Toward Global Earthquake Safety

Colorado State University

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Executive Summary

Context

The Global Earthquake Model (GEM) Foundation is now at a point in its organizational history when it is ready to begin developing tools and resources for individuals who are not earthquake risk assessment experts. The research project described in this report was designed to learn about the needs of these individuals worldwide, in order to provide information that could help to guide GEM's future tool and resource development.

This project is an important initiative, as user needs are often not assessed prior to the development of scientific or technical tools. That lack of user needs assessment has contributed to a gap between what decision-makers and end users say that they want from science and technology, and what science and technology offer to decision-makers and end users.

Fortunately, the gulf between scientific communities and policy-maker and practitioner communities is not so great that it cannot be overcome. Engaging in dialogue and needs assessments—such as the one described in this report—across the divide is one of the best ways to begin to build bridges between these communities.

Goals

This report summarizes the findings of an 18-month-long research project led by GeoHazards International (GHI) and Colorado State University's (CSU) Center for Disaster and Risk Analysis, to achieve the following overarching goals:

(1) To discover the needs of selected GEM beneficiaries[1]*; and*

(2) To describe how GEM can most effectively communicate its earthquake risk information to these beneficiaries to promote risk mitigating action.

Methods, Participants, and Study Sites

To accomplish these aims, the GHI-CSU team designed and led a research project that included in-depth interviews and surveys with earthquake safety practitioners from government, business, health care, education, and grassroots groups. These practitioners hold many different positions and have a range of job titles and responsibilities that include, for example: government hazard analysts, identifying hazards within cities or districts to inform land-use policies; emergency planners, implementing preparedness measures throughout school districts or hospitals; and

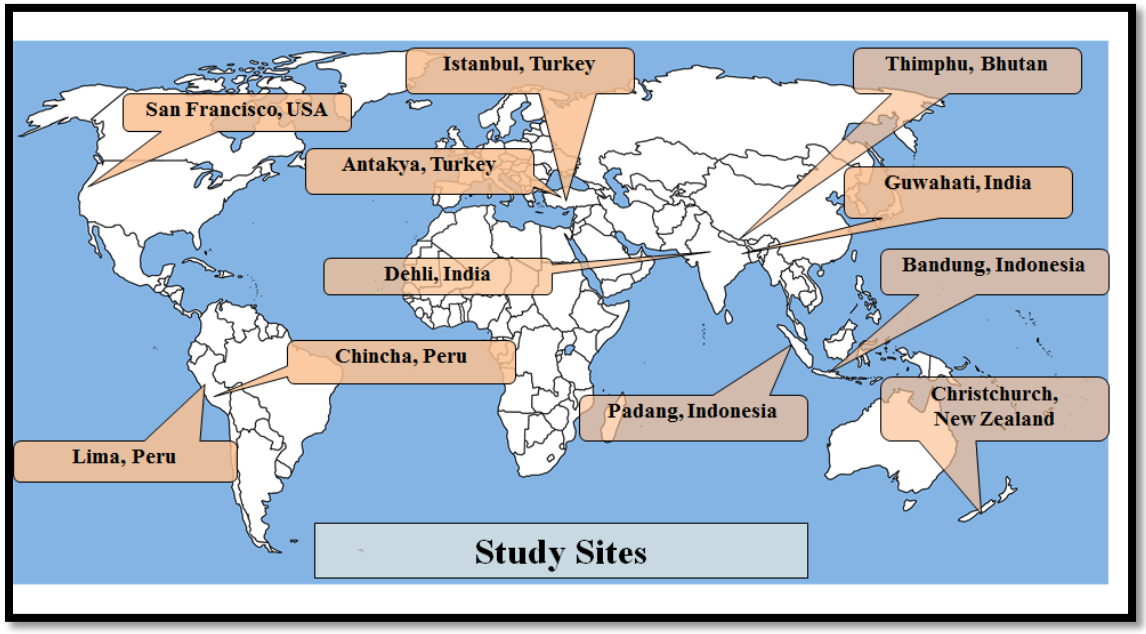
[1] The project team decided, after consultation with the GEM Secretariat, to expand the scope of the study to include respondents in both developing and high-income countries. This aligned the study with GEM's mission of communicating risk information to beneficiaries globally.

program coordinators, leading their non-profits' efforts to help vulnerable populations reduce earthquake risk in their homes and local communities.[2]

Individuals were selected for inclusion in the study based on the following two primary criteria: (1) high levels of involvement in earthquake risk reduction activities at the organizational or community level, and (2) capacity to influence decision-making within their organizations or local communities.

Respondents represented the following 11 cities across seven countries:

- Antakya and Istanbul, Turkey;
- Bandung and Padang, Indonesia;
- Chincha and Lima, Peru;
- Christchurch, New Zealand;
- Delhi and Guwahati, India;
- San Francisco, USA; and
- Thimphu, Bhutan.



During the field visits, the project team also interviewed five local officials from international development organizations including the World Bank, the United Nations Development Programme (UNDP), and the United Nations Children's Fund (UNICEF). The purpose of these meetings was to introduce the officials to GEM and to explore whether or not these agencies might be interested in using GEM's information in their own risk management activities.

[2] For the sake of simplicity, this broad group of professionals is referred to as "earthquake safety practitioners," or "practitioners," throughout the report.

In addition, the GHI-CSU team conducted four interviews to explore how GEM could use so-called "Web 2.0" technologies. Two of these interviews were with Web 2.0 experts, and two were with individuals at the U.S. Geological Survey who have experience using Web 2.0 tools (particularly social media) to communicate scientific information to lay audiences.

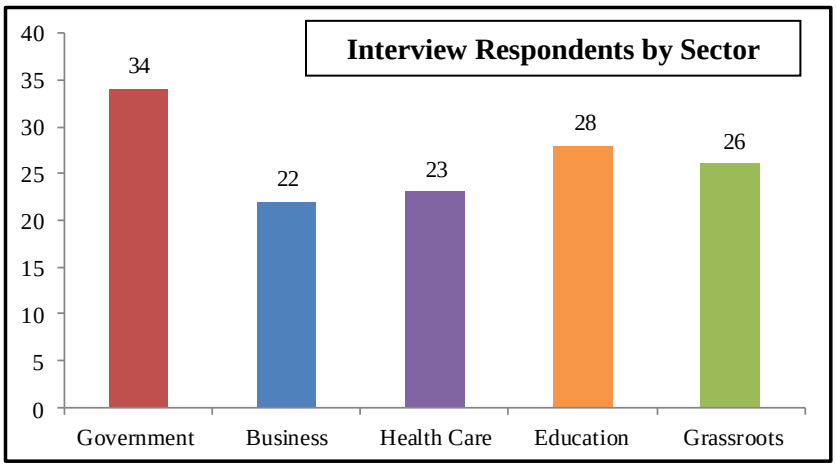
Research Questions

The following questions guided this project:

- What earthquake risk reduction programs and initiatives are already underway in the 11 target cities? What prompted the creation of these programs and initiatives?
- What tools and resources do practitioners currently use to assess and mitigate their earthquake risk?
- What communication channels do these practitioners prefer to use to communicate with colleagues and the public?
- What tools and resources do these practitioners say that they would like to have, in order to better communicate earthquake risk? What functionalities would these practitioners like to see integrated into these tools?
- What barriers do practitioners confront in acting to reduce their communities' earthquake risk? What tools and resources could GEM provide that would help practitioners and community leaders to overcome these barriers?
- How can GEM help these practitioners to better understand and ultimately mitigate their communities' earthquake risk?
- Which practitioners are most likely to adopt and use GEM's tools?

The Report

Chapter 1 provides an introduction to the research project and an overview of the methodological approach, study site selection, participant sampling strategy, and data collection timeline. Chapter 1 also describes the five key sectors that the team focused on in this project: (1) government, (2) business, (3) health care, (4) education, and (5) grassroots organizations. Each of these sectors plays a crucial role in reducing earthquake risk and promoting a culture of safety in communities around the world.



Chapter 2 offers a summary of the key programs and activities in place in the cities that the GHI-CSU team visited, and an analysis of the factors that sparked the creation of those programs. The data in this chapter provide strategic information about how and when GEM might introduce its platform and tools to practitioners. Indeed, the results offer insight into currently used products, potential points of contact and/or windows of opportunity to integrate GEM's tools into new or existing programs and initiatives, and what communication channels are most useful for practitioners to receive GEM information and tools.

The results show that the numerous programs and activities underway in these cities address both mitigation and preparedness through local initiatives and through nationally- and internationally-sponsored programs. The programs are designed to assist and/or engage different levels of society, ranging from

- individuals and households;
- schools, hospitals, businesses, local government, community- and faith-based organizations;
- neighborhoods and communities; to
- regional, national, and international policymaking bodies.

Many factors spurred the creation of these programs and activities, including: (1) the occurrence of a disaster; (2) new risk reduction-oriented legislation and regulations; (3) available local/state/national funding; (4) external support and international guidance; and (5) hazards and vulnerability concerns, the making of mitigation champions, and strong leadership. Chapter 2 details how each of these factors affects implementation of a program and offers insights into when GEM might introduce its future tools.

Chapter 2 also describes the technical resources used by practitioners, the sources that practitioners use to find technical resources, and organizational strategies for disseminating earthquake risk information to others. Most importantly, the team discovered that across the 11 cities, practitioners reported that they lack one central technical tool or resource that provides a comprehensive portrait of earthquake risk in their cities. Instead, respondents regularly attempt to draw together technical resources from different sources to get some sense of the potential impacts of future earthquakes on their cities' lifelines, critical infrastructure, and population groups. A majority of practitioners interviewed acquire technical information regarding earthquake risk from secondary sources either online or in reports from outside organizations. Only a small number actually collect primary hazards, infrastructure, and socio-demographic data to generate their own city-specific "risk profiles." So few practitioners engage in risk profile creation because such a task is technically difficult and time-consuming and access to the required primary data sources is limited.

Across the 11 cities, practitioners reported that they lack one central technical tool or resource that provides a comprehensive portrait of earthquake risk in their cities.

Practitioners use a variety of communication channels to receive earthquake risk information, and few respondents rated any of the 13 communication channels identified in the survey as "not

useful" or "not available." The communication channels perceived by practitioners as most useful included talking with community members, visiting earthquake- or disaster- focused websites, talking in person with scientific experts, and using earthquake hazards maps. The least useful channels were perceived to be radio, government websites, and social media. This result suggests that GEM could reach earthquake safety practitioners in various geographic regions through a variety of communication channels, although some may prove to be more effective than others. Practitioners in every target city had access to the Internet, although respondents from developing countries indicated that the people that they serve through their organizations often do not have such access.

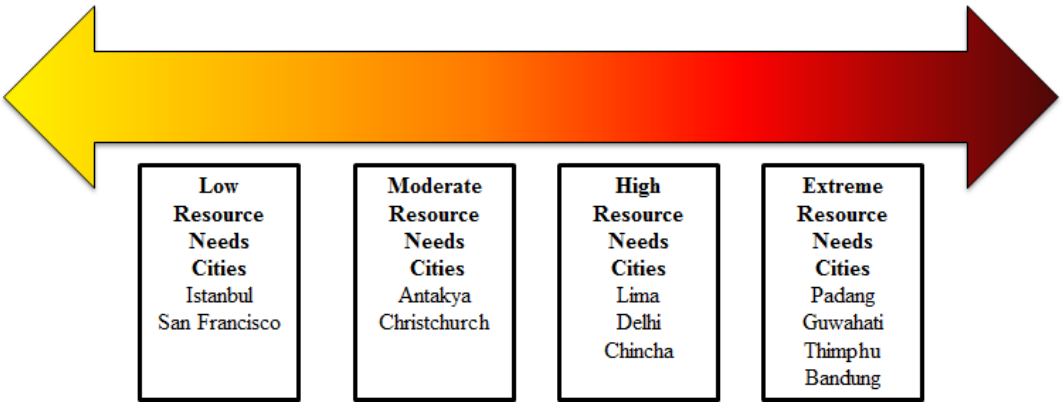
Once they have earthquake risk information, the practitioners disseminate it to the public and other groups and organizations through a variety of methods, including disaster simulations, workshops, trainings, educational classes, public meetings, broadcast media, and more. These outreach methods and strategies are detailed in Chapter 2.

Chapter 3 includes quantitative and qualitative analyses of the resources that respondents said that they needed to understand, communicate, and mitigate earthquake risk. The chapter details resource needs across the entire sample and includes city-specific and sector-specific analyses. It also describes the tools, technologies, and trust-building activities that interview respondents suggested that GEM develop. The chapter concludes with a brief summary of best practices for communicating risk to practitioners and the public.

The results from this study indicate that many needs for resources exist within the target communities. From a list of 21 resources (e.g., projected ground shaking intensity in an earthquake, maps of earthquake fault lines, access to technical experts who can explain earthquake risk), the least frequently available resources included projected damage to Internet networks and to mobile phone networks. Conversely, the most commonly available resources included materials for individual and family preparedness, projected ground shaking intensity in an earthquake, and maps of earthquake fault lines. Overall, a minority (40% or fewer) of respondents marked that they "already have" any one of the 21 resource items.

The qualitative interviews revealed that no single item of the 21 items included on the survey was "most important" to all respondents. Rather, what practitioners said time and again was that they would like to have access to *all* of the items, simultaneously, in order to better understand the risk profiles for their respective cities. This finding has particular relevance for GEM, as it develops its platform and any future tools and resources.

City-specific analyses revealed striking variance across the 11 target cities in terms of reported resource availability and reported needs for earthquake risk communication and reduction activities. The GHI-CSU team grouped the cities into four categories (low, moderate, high, and extreme) based on the extent of resource needs expressed by the respondents in those cities.



Sector-specific analyses showed much less variation than the city-specific analyses. Compared to the city-specific analyses, these results indicate that *geographic location* (i.e., whether a respondent is located in a developed or developing country context) likely has a greater impact upon respondents' reported resource needs than does *sector*.

The qualitative data elaborate on the resource needs identified in the survey. Respondents would like tools and resources that provide many different types of information, including:

- general earthquake risk information (e.g. likely magnitude of an earthquake in their city);
- multi-hazards risk information (e.g. what other hazards the city faces);
- building stock location and vulnerability (e.g. which buildings are collapse hazards);
- structural mitigation approaches (e.g. how to strengthen a building);
- non-structural mitigation approaches (e.g. how to fasten contents in a building);
- infrastructure systems, emergency evacuation, and vulnerability (e.g. how to manage traffic flows following an earthquake);
- sector-specific damage estimates (e.g., which hospitals, schools, and businesses are collapse hazards);
- social and psychological vulnerability (e.g. how to communicate risk to vulnerable groups);
- emergency response planning and simulation exercises (e.g. what resources are required to best plan for and manage a disaster); and
- best practices (e.g., what lessons can be learned from other cities and countries).

Earthquake safety practitioners represent a critical "bridge" between scientific experts and the general public. As such, practitioners regularly struggle to convey complex risk information in the most straightforward, user-friendly, and engaging ways possible.

Participants in this study reported that it would be most helpful to them if they could receive information from GEM in a variety of formats and channels, such as:

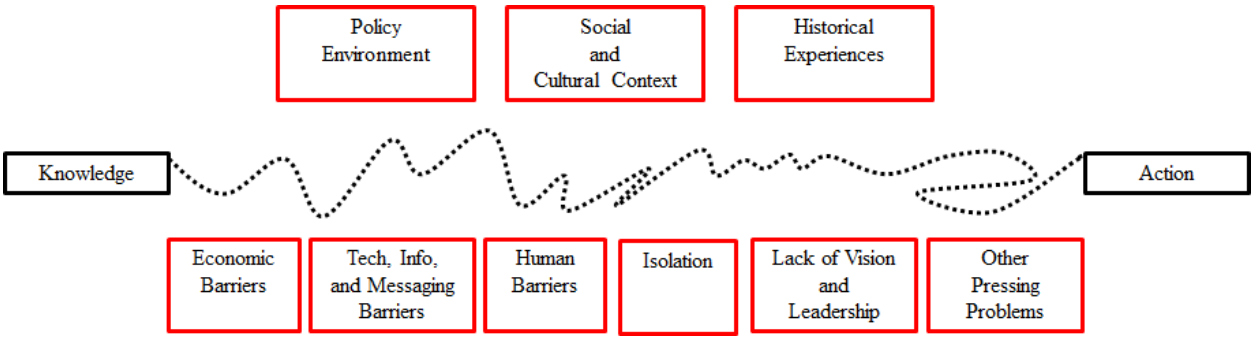
- *maps,*
- *charts,*
- *tables,*
- *short handouts or briefing papers,*
- *posters,*
- *brief, descriptive narratives highlighting mitigation and preparedness success stories,*
- *PowerPoint™ slides,*
- *in-person or web-based presentations by GEM experts,*
- *online simulations or games,*
- *customizable computer programs,*
- *web-accessible videos, and*
- *web pages designed with the general public in mind.*

Respondents provided general requests and recommendations for the tools that GEM may develop. These requests and recommendations included: (1) user-friendly tools that require little time to learn; (2) tools that employ clearly defined and consistent terminology; (3) customizable, site-specific, and sector-specific tools that provide more particularized information for their communities; (4) tools with the most current, up-to-date information possible; (5) technology that would integrate disparate information sources; and (6) more consistent access to technical experts able to explain their earthquake risk and to help convince decision-makers of the importance of funding and supporting mitigation and preparedness activities.

In order to adopt any tool, however, respondents indicated that they must trust it and its information sources. They indicated that such trust would depend upon their believing that credible, clearly articulated "sound science" was behind the tool or resource; upon trusted organizations and/or individuals endorsing the tool; and upon evidence suggesting that the new product had a relative advantage or was "better" than what they were already using.

Chapter 4 offers a discussion of the various barriers respondents face in carrying out their work. It is clear that even the most knowledgeable and informed participants in this study are often unable to overcome the multiple, substantial barriers inhibiting their ability to "get things done." Indeed, the GHI-CSU team interviewed many exceptionally smart, talented, and motivated earthquake safety practitioners, who are desperate to reduce risk in their communities but are repeatedly stymied by different obstacles. GEM's tools will be more effective at helping users to promote mitigating actions, if its tools and resources help practitioners to overcome at least some of these barriers.

Barriers to Earthquake Risk Reduction



The barriers identified in the red boxes above represent the nine "meta-themes" that emerged in the GHI-CSU team's analysis of the interview data. These barriers were often described as tightly interconnected and overlapping challenges that obstructed the "knowledge-to-action" path for practitioners working to reduce earthquake risk. Each of these barriers included numerous sub-barriers, which are detailed in Chapter 4.

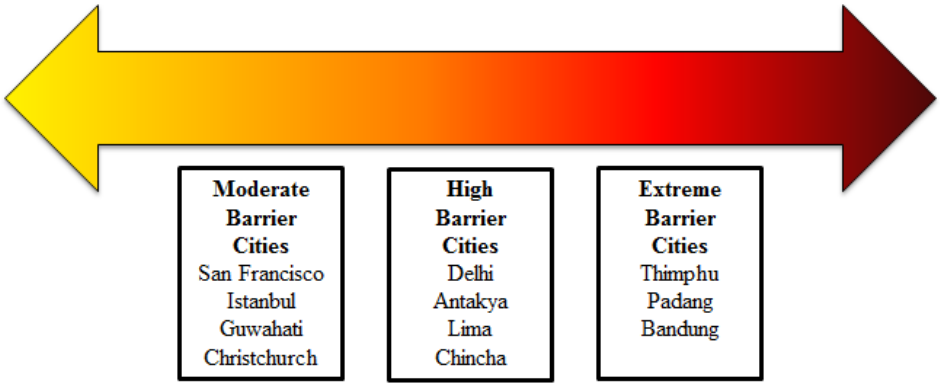
The survey data provide additional information about nine pre-identified barriers. Across the 11 target cities, a lack of money was the most commonly cited major barrier to earthquake risk reduction, while the least commonly cited major barrier was lack of interest among colleagues. Over half of all survey respondents indicated that *all* nine items listed on the survey are either minor or major barriers.

Major Barriers to Earthquake Risk Reduction

Barrier Item	Rank
Money	1
Other social/economic problems	2
Lack of available personnel	3
Lack of technical expertise	4
Lack of interest among the public	5
Lack of earthquake information	6
Other serious hazards	7
Time	8
Lack of interest among colleagues	9

Note: 1 = most common barrier, 9 = least common barrier.

City-specific analyses of barriers indicate variability in barriers faced by different geographic locations. The team grouped the cities into three categories (moderate, high, and extreme) based on the extent of barriers expressed by the respondents in those cities.



Sector-specific analyses of the barriers showed much less variation than the city-specific analyses of barriers. Compared to the city-specific analyses, this result indicates that *geographic location* likely has a greater impact upon respondents' reported barriers than does *sector*.

GEM cannot reduce all of the barriers identified in this study. But GEM is well positioned to help practitioners address the barriers of (1) lack of technical expertise, and (2) lack of earthquake information. These two barriers affect certain cities and sectors more than others. Indeed, participants from cities in less developed countries experience more extreme difficulty in accessing both technical expertise and earthquake information.

Overall, these results indicate that cities in countries with higher United Nations' Human Development Index (HDI) scores tended to have more access to resources and to experience fewer barriers to risk reduction than did cities in countries with lower HDI scores. Within a given country, cities that had larger population sizes and more recent exposure to large earthquakes tended to have more access to resources than did cities with smaller population sizes and more distant exposure to large earthquakes.

Recommendations

The report also includes numerous recommendations to the GEM Foundation. The purpose of the recommendations is to turn the research project's findings into actionable steps that GEM could take to work with practitioners in seismically-prone communities around the world. The project team endeavored to connect its recommendations to GEM's mission and goals.

Recommendations

This section presents the GHI-CSU team's recommendations to the GEM Foundation. The purpose of the recommendations is to translate the research project's *findings* into *actionable steps* that GEM could take. In drafting the recommendations, the project team also drew from numerous meetings and discussions with the GEM Secretariat staff, which helped to clarify GEM's intended future directions; and from a March 2012 workshop in Pavia, Italy, which brought together the GHI-CSU project team, GEM Secretariat staff, GEM advisors, and selected respondents, in order to provide the team with feedback on a draft version of this report. Throughout this section, the project team endeavored to connect its recommendations to GEM's stated mission and goals.

The recommendations are structured into four categories:

A. Focus and Clarify GEM's Efforts
B. Develop a Comprehensive Tool that Helps Practitioners Take Action
C. Train and Support Users
D. Develop Strategies for Post-Disaster Windows of Opportunity

The sequence in which these categories, and the recommendations within each category, are presented is not meant to suggest a ranking by importance. Rather, the categories are used to organize recommendations by theme and to make this section easier for readers to follow.

The GHI-CSU team recognizes that GEM is a collaborative and evolving effort that involves many individuals and organizations around the world. The recommendations that follow are addressed simply to "GEM," because the team is not in a position to know when a contractor or partner, rather than the GEM Secretariat, would be the appropriate entity to implement a specific recommendation. Similarly, while the following recommendations apply to GEM's risk assessment platform, website, associated tools and resources, and yet-to-be-conceived services and web-based products, the team often refers both in this section and the larger report simply to "GEM's platform" or "GEM's tools."

A. Focus and Clarify GEM's Efforts

Recommendation A.1. Focus time and resources on the needs of earthquake safety practitioners by:

- Addressing the particular needs of earthquake safety practitioners in the development of GEM's risk assessment platform, website, and associated tools and resources.
- Developing strategies and mechanisms for obtaining regular input from practitioners on the development of GEM's platform.
- Appointing one or more earthquake safety practitioners to the appropriate board(s) and/or working group(s) within GEM's organizational structure.

There are a number of important reasons why GEM should dedicate resources to serving the needs of earthquake safety practitioners, among other designated users. These practitioners (1) have a demonstrated interest in reducing disaster risk in their communities and therefore,

are likely to view GEM's resources as valuable; (2) have expertise in earthquake risk reduction, are familiar with many of the key concepts and the terminology used in the work, and understand the role and importance of communicating risk information to the broader public; (3) have formal responsibilities and authority, associated with their professional positions, to promote and implement risk reduction activities; (4) have expressed an interest in and need for the type of risk information that GEM can provide; (5) are potential "early adopters" of GEM's risk platform and website; (6) work in diverse sectors which, taken as a whole, represent a significant portion of any community's or nation's economic, political, and social activities; and (7) represent a critical "bridge" between the scientific world and the broader public.

GEM should solicit input early and regularly from practitioners, through user testing or other such mechanisms, on prototypes or mockups of tools that GEM plans to build. Input from practitioners will help GEM to develop products that best meet their needs.

Earthquake safety practitioners have a range of technical skills and earthquake-related knowledge, and their skills and knowledge will affect their abilities to learn and effectively use GEM's products. Most practitioners interviewed for this study had limited, if any, experience in using computer models to analyze earthquake risk. Instead, the majority use maps and other risk information compiled by scientific experts and then translated for practitioners; they in turn translate that information for residents in their communities. GEM should take this information translation and transmission dynamic into consideration, as it further refines its current "user groups" (i.e., "pro, advanced, and basic") and designs its risk assessment platform and tools.

Recommendation A.2. Focus on the needs of earthquake safety practitioners working in specific key sectors, including government, business, health care, education, and grassroots organizations. To accomplish this, GEM could:

- Identify through early input and user testing—or other systematic methods for receiving feedback on prototypes or mockups of tools that GEM plans to build—specific functionality needs of users in key sectors of society, and address those needs in the development and refinement of GEM's products.
- Explicitly and consistently identify these sectors on GEM's platform and website and in its marketing/outreach material as potential users of GEM's tools.
- Modify GEM's platform and website, so that a user can select content customized for specific sectors. These sector-specific sections would:
    - Employ text and graphics—such as images of businesses, schools, or government buildings—that depict or suggest these sectors.
    - Provide tools and resources tailored to the identified needs of these sectors.
    - Provide information and/or links to risk reduction best practices and case study examples for these sectors.
    - Provide links to online communities, or networks, where users can meet and exchange ideas with other practitioners working in these sectors.
- Include pictures and brief vignettes of earthquake safety practitioners worldwide, attesting to the quality and value of GEM's products in their risk reduction activities.

Respondents said that what they wanted, and typically lacked, was risk information targeted to the sectors in which they work. For example, health care officials wanted to map the location of all hospitals and health care facilities in relation to their seismic hazards, and to have community-wide estimates of deaths and injuries following large earthquakes. School district officials, by contrast, wanted to know where the most vulnerable schools in their cities were located. Practitioners in each sector wanted risk information about the buildings and physical infrastructure that were essential to their work.

Distinct feature requests across sectors should become even more apparent as GEM begins user testing. Even if more sector-specific needs do not emerge through user testing, GEM could still opt to present its tools in ways that appear to be customized to different sectors. The more that GEM makes its platform and tools sector-specific, the more likely it is that practitioners will perceive the tools to be designed for them and will adopt GEM's products.

GEM also should consider these five key sectors when developing marketing/outreach strategies and designing training and support mechanisms for users (see Recommendation C.1). As previously noted, these sectors, taken as a whole, represent a significant portion of any community's or nation's economic, political, and social activities. If GEM does not have adequate resources to focus on all five sectors, then it should, at a minimum, focus on the government and grassroots sectors. Government has a unique capacity to significantly influence practices in other sectors. That said, in many countries government is mistrusted, inefficient, and unresponsive to the needs of constituents. GEM would miss an important opportunity to empower people with risk information, if it focused solely on government. By also focusing on the grassroots sector, GEM would increase the chances that its products would be used to promote risk reduction in a given city. Additionally, respondents working in the grassroots sector reported encountering the fewest barriers to accomplishing effective earthquake preparedness and mitigation activities, which indicates that this sector might be able to use GEM's tools more productively than could other sectors.

Recommendation A.3. Focus, at least initially, on a more narrowly defined group of users than is listed on GEM's website.

GEM states on its website that it envisions supporting many types of users, including those from the private and public sectors, non-governmental organizations, international bodies, and individuals living in earthquake-prone areas. GEM's website also lists other, more specific, target users: civil protection departments, national ministers of economy, reinsurers, global primary insurers, risk managers at multinational corporations, geologists, engineers, university researchers, entrepreneurs, local government agencies, urban planners, geophysicists, and individual homeowners.

This project investigated the needs of earthquake safety practitioners from five key sectors. Even within this relatively limited group of potential GEM users, the GHI-CSU team found substantial variation in the resources that practitioners have, the resources that they would like to have, and their technical capacity to use and apply GEM's risk information. Considering this diversity, and the difficulties associated with reaching such a wide and varied group, GEM should concentrate, at least initially, on developing tools for a more

narrowly defined group of users than is listed on its website. In selecting this group of users, GEM should consider other regional or global initiatives that are focused on earthquake risk assessment and mitigation, in order to identify how GEM might best complement these efforts, expand upon work that is already available, and avoid duplication.

GEM should also clearly distinguish between its *intended users*—that is, people who will visit its risk assessment platform or website to access tools and resources—and the significantly larger population of individuals and organizations that might, one day, *benefit* from the availability of GEM's risk information, such as homeowners who live in a city that has become more resilient through a local initiative that relied on GEM's information.

Recommendation A.4. Clearly communicate the anticipated and actual level of detail of GEM's risk information.

Generally speaking, the more specific GEM's information is, the more useful it will be in communicating risk information and promoting mitigating action. Will GEM provide risk information at a citywide level? At the level of a neighborhood, within a city? Will GEM provide risk information about a specific subset of buildings—such as schools, government offices, or housing—and specific infrastructure at the city or neighborhood level? This project's research revealed that many potential users working at the community level will decide whether or not to use GEM's tools based on the granularity of the information that they will provide. For example, some practitioners said that they would view GEM's tools as unhelpful, if the tools do not provide information about specific buildings or infrastructure.

As GEM continues to focus its efforts on the needs of particular users, GEM can avoid fostering unrealistic expectations about the capacity of its products by clearly communicating how specific its risk information is expected to be. GEM should also clearly communicate the uncertainties associated with its risk calculations.

Recommendation A.5. Clearly describe what GEM's tools and resources will help practitioners to achieve.

When the project team asked practitioners what tools and resources GEM should develop, some responded, in turn, by asking what GEM intends to help them accomplish in their organizations and local communities. In other words, these practitioners first needed to understand what GEM's tools and resources might help them to achieve, in order to offer specific suggestions about what the tools and resources should be. The consistency of this trend in the data suggests that practitioners are likely to have this same question, when they first encounter GEM's marketing/outreach materials or visit GEM's website or platform. If GEM outlines clearly how its products can help practitioners to accomplish their work, then they will be more likely to use GEM's tools and resources.

GEM should consider providing answers to the following types of questions on its website and in its marketing/outreach materials: For which size cities does GEM intend to provide risk information? What specific information will GEM's risk assessment platform and website offer that can be used at the city level? How will GEM's tools and resources help

users to think through, design, and implement mitigating actions? This last question is of particular importance to practitioners. As noted in Recommendation B.2, many practitioners who participated in this study were aware that their communities were at high risk, but they were unsure of how to prioritize risk reduction actions.

B. Develop a Comprehensive Tool that Helps Practitioners Take Action

Recommendation B.1. Develop a comprehensive tool and other associated resources that help earthquake safety practitioners to understand and communicate the earthquake risk of their communities.

Respondents across all 11 of the target cities said that they lack, and urgently need, one central tool that they can rely upon to provide a comprehensive picture of the earthquake risk of their communities. Practitioners want and need access to information related to earthquake exposure; projected damage to housing, schools, businesses, roads, and other critical infrastructure; and projected impacts—including deaths and injuries—on different population groups. Although practitioners with lower expressed resource needs,[3] such as those working in San Francisco, currently have access to more risk information than do practitioners in higher needs cities, such as Padang, respondents overwhelmingly stated that the more specific GEM's risk information, the better, and the more comprehensive GEM's risk information, the better.[4] The project team firmly believes that if GEM is able to develop one comprehensive tool that draws together information on earthquake exposure, projected damage, and projected impacts for nations and cities, then GEM will be positively received and its tool and resources will be widely adopted globally.

Once practitioners have access to risk information, they and their organizations make decisions about how to manage risk based on a variety of cultural and values-based systems. One group may prioritize cost savings over everything else, while housing availability, the preservation of cultural property and historic neighborhoods, tourism, or job creation could be of paramount importance to others. GEM cannot predict which expected impacts will be most important to users, because different users will have different values (as will the final beneficiaries, whom its users are trying to persuade to act). Therefore, the more flexible and comprehensive GEM's tools are in presenting and emphasizing different components of risk, the more attractive the platform will be to users.

[3] See Section 3.1.1 of the report for a description of what characterizes lower and higher resource needs cities. In general, lower resource needs cities will have higher United Nations Human Development Index (HDI) scores than will higher resource needs cities (see Section 4.3 for a more detailed discussion of the HDI scores across the target countries).

[4] Respondents clearly said that they wanted sector- and site-specific data. However, respondents were not asked to consider the technical feasibility of their requests, nor were they asked to consider the costs of generating granular risk data. Risk information provided at a scale that is coarser than site-specific is still helpful in promoting and implementing risk reduction initiatives. See, for example: Spangle, William E., ed. 1987. Pre-Earthquake Planning for Post-Earthquake Rebuilding (PEPPER). Los Angeles: Southern California Earthquake Preparedness Project.

Recommendation B.2. Develop additional tools and resources that help earthquake safety practitioners to make decisions about actions that they could take to reduce their earthquake risk. These could include:

- Additional tools that calculate estimated costs and potential benefits of various preparedness and mitigation options. These tools might graphically display the expected impacts, over time, of different measures on a region's or community's risk profile, in order to help users select the most effective options.
- Tools that—to the greatest extent possible—help users to identify the most vulnerable buildings, or building types, among a portfolio and that provide some measure of expected damage, expressed either probabilistically or deterministically, for each building type.
- Tools that allow users to experiment with or manipulate underlying factors, such as vulnerability or exposure, affecting a community's risk, providing insight into which interventions could have the largest impact.
- Tools that display a community's risk profile in terms of its expected "states of recovery," such as for buildings, infrastructure, and essential services, providing insight into which elements of society are least resilient and in most need of intervention.[5]
- Resources, or links to reliable websites with resources, that describe—drawing on best practice or case study examples—frequently implemented risk reduction measures that should be considered by communities or organizations.

The practitioners who participated in this study were already well aware that their communities were at high earthquake risk. But this awareness did *not* always lead directly to mitigation action. Among other barriers to action, one of the most prominent was the fact that practitioners and policy makers were unsure of how to prioritize risk reduction actions and resources in their communities. Across the cities, practitioners expressed a strong desire to collaborate with experts who could help them to make decisions about how, when, and where they should focus their mitigation and preparedness efforts. If GEM could support this critical analytic step in the mitigation and preparedness lifecycle, as by building the tools described above, then users would be better equipped to reduce risk and increase resilience in their communities and would be more likely to adopt the tools and resources that GEM eventually offers.

Recommendation B.3. Treat the following as "core requirements" of GEM's website, platform, and associated tools and resources:

- User-friendliness.
- Clearly defined and consistent terminology.
- Current, regularly updated earthquake risk information.
- Customizable site- and sector-specific options for viewing risk information.

[5] Even if it is not technically feasible for GEM's tools to generate recovery estimates for specific cities, a tool that provides a framework for users to describe and quantify their communities' resilience will be helpful for practitioners. For an example of a resilience framework that uses states of recovery, see: http://www.spur.org/policy/the-resilient-city.

- Interoperability with software applications and datasets frequently used by practitioners, including the ability to compile and integrate within GEM's platform multiple, outside sources of information on hazards exposure and vulnerability.
- Compatibility across common desktop and mobile computer operating systems.

Practitioners—particularly those who live in low resource needs cities, such as San Francisco and Istanbul—already have access to a range of risk-related information, such as exposure data. Therefore, GEM's products should be compatible with the software applications and datasets frequently used by practitioners for understanding and assessing risk. (See Section 2.3 for more information about the technical resources used by practitioners and how this varies by city.)

In addition to the above core requirements, GEM's tools and resources could offer the following features:

- An easy-to-navigate, visually appealing graphical user interface (GUI).
- An option to view the content and any accompanying user guides that GEM develops in different languages.
- An online "wizard," or assistant, to guide users, step-by-step, through the process of customizing risk assessment information. This wizard might also include a "definition" feature that would allow users to click on hyperlinks for technical terms, in order to read definitions of terms such as *hazards, vulnerability,* and *risk* in plain language.
- The ability to generate probabilistic and deterministic seismic risk analyses.
- The ability to customize outputs, subject to the availability of data, so as to select and display those components of risk (e.g., expected impact on schools or hospitals, expected impact on specific population groups) that are most important and relevant to the user. (See Chapter 3, and especially Tables 3.1, 3.2, 3.3, and 3.4, for specific components of risk information that respondents reported that they need. See Section 3.3 in the same chapter for additional information on effective risk communication strategies.)
- The ability to display outputs in various formats (e.g., charts, tables, maps, animations), including visual displays of information that can be easily understood, with limited accompanying explanation, by people who are not scientific experts. (See Section 3.2.1 for more information about how respondents would like to see outputs displayed.)
- The ability to export outputs into common file formats, such as .JPG, .PNG and .XLS.

In developing its platform and website user interfaces, as well as its risk information outputs (e.g., maps, infographics), GEM should emphasize ease of use. Risk reduction measures are usually undertaken only after decision-makers (who are typically not earthquake experts) support those actions within their communities or organizations. Thus while scientists, engineers, and earthquake safety practitioners might be the immediate target users of GEM's risk information, the final target beneficiaries of the information are likely to be people with limited understanding of earthquake risk, who are balancing competing priorities. With this in mind, GEM should allocate resources to developing innovative ways to communicate earthquake risk information to lay audiences. This offers an opportunity for GEM to differentiate itself from other seismic risk assessment tools and resources.

GEM's platform should support the capability to generate both probabilistic and deterministic risk analyses. Deterministic risk analysis is needed to create earthquake "scenarios," which are widely used by practitioners as important tools for promoting disaster preparedness and planning.[6,7]

Recommendation B.4. Seek the endorsement of GEM's scientific and engineering rigor by key, widely respected scientific institutions within targeted countries.

GEM's risk information will contribute more to raising awareness and promoting mitigating action within a country, if the science and engineering supporting its risk assessment tools have been endorsed in a way that convinces national and local decision-makers. Respondents said that they would be more likely to trust and use GEM's products if GEM were endorsed by widely-respected scientific institutions within their countries. (See Appendix L for a list of trusted organizations and trusted individuals identified by respondents from each of the target cities.) In some cases, endorsement by respected foreign scientific institutions, as well as local ones, would enhance GEM's perceived trustworthiness.

It would be impractical for GEM to seek endorsement from institutions in every country. But GEM could seek endorsement within a few select countries—such as those with recognized scientific and engineering leadership—in the major geographic regions of the world with seismic hazards.

C. Train and Support Users

Recommendation C.1. Develop mechanisms for training, supporting, and connecting earthquake safety practitioners in using GEM's risk assessment platform. The mechanisms could take the form of:

- Free and easily accessible online training modules.
- Periodic webinars, in which scientific and engineering experts would provide tutorials on how to use GEM's risk assessment platform and take questions from participants.
- Seminars or classes at hazards conferences on how to use GEM's risk assessment platform. GEM could organize conferences or present sessions at existing annual meetings that are widely attended by earthquake safety practitioners.
- An online list of frequently asked questions, customized to the specific needs of practitioners, on how to use GEM's risk assessment platform.
- A directory of technical experts affiliated with GEM, who could provide workshops, seminars, or one-on-one mentoring to interested users.
- An online collaborative forum where practitioners and other users could ask for help, support one another, and share best practices.
- "Case studies" of how users have assessed risk using GEM's tools, highlighting key assumptions and decisions made in the process. These examples could serve as a kind of guide for newer users, as they begin using GEM's products.

[6] See Earthquake Engineering Research Institute: http://www.eeri.org/projects/earthquake-scenarios/.
[7] Brian Tucker, Mustafa Erdik, and Christina Hwang, eds. 1994. *Issues in Urban Earthquake Risk.* Dordrecht: Kluwer Academic Publishers.

Practitioners in all 11 of the target cities in the study expressed a strong interest in using GEM's tools and resources, once developed. However, respondents indicated that they want and need training on new risk assessment tools. Practitioners across all surveyed sectors and cities also want more consistent access to scientific experts, who can help to explain their earthquake risk. By providing training and support, through various media, GEM will increase the likelihood that its tools will be adopted and used correctly and effectively.

These training and support mechanisms will be particularly effective, if they also help earthquake safety practitioners to communicate, share information, and provide advice on the use of GEM's tools and resources. Respondents frequently cited limited networks *across* hazard-prone communities and limited networks *between* disaster-focused organizations within communities or countries as barriers to implementing risk reduction measures.

Importantly, practitioners in different cities and countries have different levels of technical expertise, which influences their ability and willingness to adopt new technologies. Regarding their ability, GEM is likely to need to provide more training, support, and capacity building for users in higher resource needs cities. In terms of willingness, practitioners in higher resource needs cities have fewer existing risk-related tools at their disposal and are more likely to adopt GEM's products (assuming that they have the ability or are trained to use them). It is worth noting that practitioners in all of the target cities had access to the Internet, which suggests that GEM could use Internet-based products and services to reach out to and train practitioners. (See Section 2.4 for more information on the communication channels and technologies used by respondents.)

Recommendation C.2. Create a "GEM Fellows" program to recognize and support the efforts of earthquake safety practitioners in communities worldwide.

Potential GEM Fellows are individuals with the capacity to combine technical understanding and knowledge with practical application. These practitioners should be well-connected within their own and other communities (allowing for "vertical" leadership within their own communities and "horizontal" leadership across communities). An easy starting point for selecting GEM Fellows would be to draw upon the list of 11 local partners and 133 respondents in the 11 target cities of this project (See Appendix F, G, and H).

A GEM Fellows program would provide a way for GEM to move beyond calculating risk and into helping users think through, design, and implement mitigating action. The fellows should be trained to use GEM's risk assessment platform and should receive stipends as remuneration for their using GEM's tools and resources to promote and/or implement risk reduction activities in their local communities. The fellows should also be paired with advisors who could help to strategize about ways to promote risk reduction using GEM's information. GEM should consider providing multi-year commitments to fellows, in order to allow sufficient time for them to make progress on the risk reduction activities they pursue.

D. Develop Strategies for Post-Disaster Windows of Opportunity

Recommendation D.1. Develop strategies to take advantage of the windows of opportunity for risk reduction that follow most large earthquakes, in order to raise awareness and help earthquake safety practitioners achieve their goals. These strategies could take the form of:

- Creating tools that allow users to quickly compare and contrast their communities' vulnerabilities, social and economic profiles, expected losses, and projected recovery times with those of a community recently affected by a major earthquake.
- Developing plans to organize training sessions on the use of GEM's risk assessment platform in affected cities and surrounding regions at a suitable time after the event.
- Devoting resources to expand the GEM Fellows program in the affected area and neighboring regions at a suitable time after the event.

Although a range of factors sparked the creation of the programs that existed in the 11 target cities, the most important and widely-cited influence was the occurrence of a disaster in the respondent's home community or in a nearby region. In short, disasters are focusing events. This finding poses a challenge for mitigation specialists: if social change is most achievable in the wake of a disaster—if that is the period when practitioners most often adopt new technologies, forge new alliances, and create and fund new programs—then how can those interested in mitigation use this knowledge to help communities with high earthquake risk?

GEM representatives have clearly indicated that GEM is not in the business of disaster response and recovery. Still, the period following a natural disaster may present *the* window of opportunity for GEM to be introduced and successfully adopted in communities newly determined to understand and mitigate future risk. For this reason, GEM should capitalize on the post-disaster window of opportunity—that moment of heightened awareness and willingness to act—to reach out to other cities with significant seismic risk, in order to promote mitigating action.

Chapter 1 Introduction and Overview

The Global Earthquake Model (GEM) Foundation is a public-private partnership that drives a collaborative effort aimed at developing and deploying tools and resources for earthquake risk assessment worldwide. GEM has brought together hundreds of organizations and technical experts from around the world. These groups and individuals are working together on databases, methodologies, tools, and open source software designed to leverage scientific knowledge for the benefit of society.[8]

Recent devastating earthquakes in the Indian Ocean, Pakistan, China, Haiti, New Zealand, and Japan serve as painful reminders of the urgent need to disseminate GEM's scientific and technical information to earthquake safety practitioners working in the world's most seismically vulnerable communities. With this context in mind, in December 2010, GeoHazards International (GHI) and Colorado State University's (CSU) Center for Disaster and Risk Analysis[9] began an 18-month research project[10] guided by two overarching goals:

(1) To discover the needs of selected GEM beneficiaries; and

(2) To describe how GEM can most effectively communicate its earthquake risk information to these beneficiaries to promote mitigating action.

To achieve these goals, the GHI-CSU project team designed and led a research project[11] that included interviews and surveys with earthquake safety practitioners in a targeted sample of cities that experience high levels of seismic risk.[12] The project team sought to answer the following questions:

- What earthquake risk reduction programs and initiatives are already underway in these communities? What prompted the creation of these programs and initiatives?
- What tools and resources do practitioners currently use to assess and mitigate their earthquake risk?
- What communication channels do these practitioners prefer to use to communicate with colleagues and the public?
- What tools and resources do these practitioners say that they would like to have, in order to better communicate earthquake risk? What functionalities would these practitioners like to see integrated into these tools?
- What barriers do practitioners confront in acting to reduce their communities' earthquake risk? What tools and resources could GEM provide that would help practitioners and community leaders to overcome these barriers?
- How can GEM help these practitioners to better understand and ultimately, mitigate their communities' earthquake risk?
- Which practitioners are most likely to adopt and use GEM's tools?

[8] See Global Earthquake Model Foundation: http://www.globalquakemodel.org/.
[9] See Appendix A and B for biographical sketches and contact information for GHI-CSU team members.
[10] See Appendix C for an abbreviated research timeline.
[11] See Appendix D for a detailed discussion of the research design and methodological approach for this project.
[12] See Appendix E for a description of the sampling criteria for the cities studied for this project.

Early in the research design phase, after consultation with the GEM Secretariat, the GHI-CSU team decided to expand the scope of the study to include respondents working in high-income countries. This modification helped to align the team's research with GEM's mission of communicating risk information to beneficiaries worldwide, not only to those living in developing countries, and meant that the targeted sample of cities included a more comprehensive range of contexts and socioeconomic development.

After three months of project planning, the GHI-CSU team and representatives from GEM met for a two-day fieldwork training workshop in Palo Alto, California, in April 2011. Among other things, this workshop helped to prepare the team to collect data systematically across the different study sites.[13] Between June and November 2011, members of the project team traveled to 11 cities[14] in seven countries to conduct interviews and distribute surveys to practitioners. Those cities were Antakya and Istanbul, Turkey; Bandung and Padang, Indonesia; Chincha and Lima, Peru; Christchurch, New Zealand; Delhi and Guwahati, India; San Francisco, USA; and Thimphu, Bhutan (see Figure 1.1).

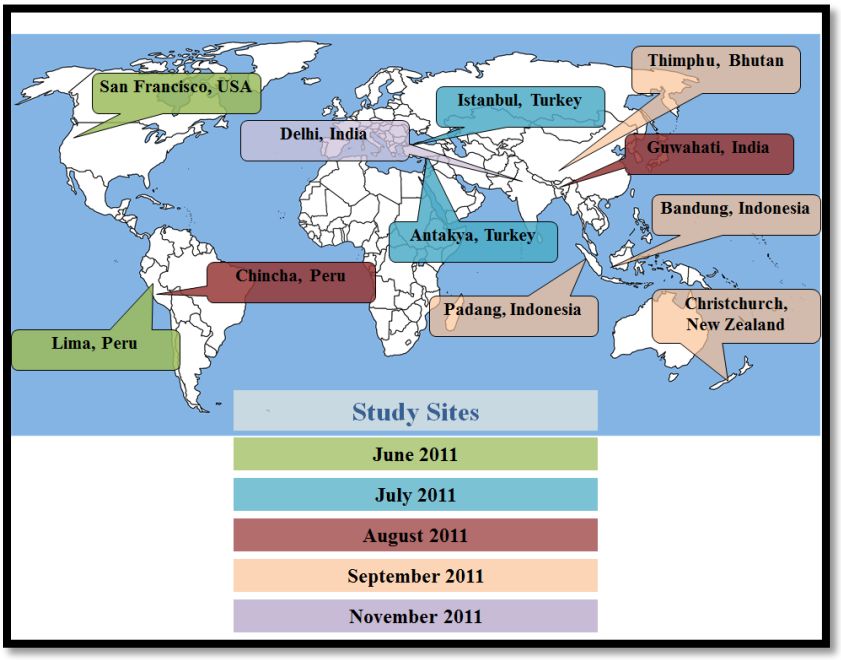


Figure 1.1. Study Site Map and Data Collection Timeline

In every city, the GHI-CSU team interviewed and surveyed two or more knowledgeable practitioners from each of five sectors representing: (1) government, (2) business, (3) health care,

[13] Over the course of this project, the GHI-CSU team developed a number of documents and other materials to systematize data collection efforts. See Appendix D for a more detailed discussion.
[14] Prior to initiating data collection, the team drafted a 15-20 page "City Document" for each of the target cities, which helped to prepare the team to visit each location. See Appendix D for a more detailed discussion.

(4) education, and (5) grassroots organizations[15] (see Figure 1.2). The team focused on these sectors of society because, as the United Nations International Strategy for Disaster Reduction (UNISDR) emphasizes, each plays a crucial role in reducing disaster risk and establishing a culture of safety in communities.[16,17] Furthermore, effective risk reduction cannot be accomplished by any one sector or stratum of society—success requires the broadest possible participation.[18] Practitioners working in each of these sectors have contact with and serve many different constituents in the public and private sectors, making them ideal target audiences for GEM's scientific and technical information. For these reasons, the team views practitioners working in each of these five sectors as potential users of GEM's tools and other resources, and as people with whom traditional earthquake experts, such as engineers and scientists, will need to collaborate with in order to build more resilient communities.

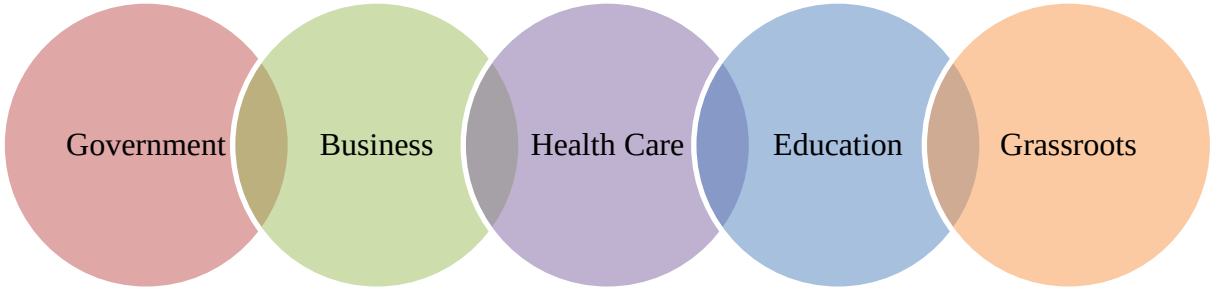


Figure 1.2. Five Key Sectors

The project team selected interview and survey respondents based upon the following two primary considerations: (1) high levels of involvement in earthquake preparedness and/or mitigation activities, and (2) capacity to influence decision-making within their organizations and local communities[19] (see Tables 1.1 and 1.2 for a summary of the final study sample).[20] In each city, the project team relied heavily upon local partners, who helped to identify leading

[15] For the sake of brevity, the term "grassroots" is used throughout the report to characterize this fifth sector, which included members of grassroots groups, religious leaders, and representatives of community-based, non-profit, and non-governmental organizations.
[16] See United Nations International Strategy for Disaster Reduction (UNISDR): http://www.unisdr.org/.
[17] Any given community may have other sectors—such as the media, criminal justice institutions, public- and private-sector housing organizations, and development associations—with important roles to play in risk reduction. However, the five sectors that the GHI-CSU team studied are present in most communities, and they represent critical institutions for the promotion and implementation of risk reduction.
[18] Marla Petal. 2007. "Disaster Risk Reduction Education: Material Development, Organization, and Evaluation." *Regional Development Dialogue Journal* 28(2): 1-25.
[19] Because this project was exploratory, the team's goal was not to draw a random sample. Indeed, it would have been impossible to do so, as in order for a true random sample to be selected, the characteristics under study of the entire population must be known. Thus, to answer the research questions, the team used an approach referred to as "key informant sampling." This type of sampling involves identifying and studying "knowledgeable individuals who have special expertise in some area of interest." For further discussion, see Appendix D.
[20] See Appendix F for a listing, by city, of the names and contact information for all study respondents.

practitioners for participation in the project.[21] In some instances, members of the GHI-CSU team had pre-existing knowledge of and experience in the study site. In those cases, the team drew upon their professional contacts, in addition to working closely with the local partner in that city.

Table 1.1. Study Respondents by City[22]

City	Survey Frequency	Percent	Interview Frequency	Percent
Antakya	9	8%	14	11%
Bandung	11	9%	12	9%
Chincha	10	8%	12	9%
Christchurch	16	14%	17	13%
Delhi	11	9%	11	8%
Guwahati	8	7%	11	8%
Istanbul	10	8%	10	8%
Lima	14	12%	13	10%
Padang	10	8%	11	8%
San Francisco	11	9%	11	8%
Thimphu	9	8%	11	8%
Total	**119**	**100%**	**133**	**100%**

Table 1.2. Study Respondents by Sector

Sector	Survey Frequency	Percent	Interview Frequency	Percent
Government	29	24%	34	26%
Business	20	17%	22	16%
Health Care	22	18%	23	17%
Education	25	21%	28	23%
Grassroots	23	19%	26	19%
Total	**119**	**100%**	**133**	**100%**

In the end, the team collected data from an array of practitioners who are actively working to reduce earthquake risk in their communities. Although these individuals were all employed by organizations representing one of the five key sectors, they were diverse in terms of their educational backgrounds, levels of professional training, and roles within their organizations. The following examples of the professional titles of some of those interviewed in each sector indicate this diversity:

[21] See Appendix G and H for biographical sketches and contact information for the local partners who assisted with the project. In addition to collaborating with the local partners as co-researchers, the GHI-CSU team interviewed these individuals at the close of each data collection trip. These interviews, which focused on the local partners' experiences in the field and their interest in assisting GEM in the future, were informal and were not audio recorded. Instead, the member of the team who interviewed the local partner took extensive notes and then typed a summary of the interview, which was later shared with the full project team.

[22] The study had a larger sample of interviewees (N=133) than of survey respondents (N=119), because additional practitioners often agreed to participate in the interviews but then had to leave before the survey was distributed toward the close of the interview.

- *Government:* Mayor, Deputy Mayor, Head of Disaster Mitigation, Emergency Manager, Master of City Planning, Engineering Technical Officer;
- *Business:* CEO/Chamber of Commerce, Business Continuity Planning Manager, Small Business Owner, Private Sector Risk Management Consultant;
- *Health Care:* Hospital Administrator, Hospital Emergency Management Coordinator, Chief Medical Officer, Surgeon, General Practitioner, Nurse;
- *Education:* Secretary of Education, Chief of the Education Directorate, Head of the Ministry of Education, Director of School Emergency Management, School Principal, Professor, Teacher;
- *Grassroots:* Community Organizer, Community Group Coordinator, NGO Executive Director, Church Leader, Partner Support Officer.

***Hakan Uslu** (pictured left) is one of the persons who participated in this study. He is a civil engineer and owner of Sigma Engineering and Laboratory in Antakya, Turkey. In 2002, he opened the first construction materials testing lab in Antakya, an ancient Mediterranean city of more than 200,000 people located in a region with a history of strong earthquakes. When Hakan started his business, he discovered that nearly half of the concrete and steel that he tested did not meet the country's minimum strength standards, and government officials were not taking steps to improve the situation.*

Hakan took it upon himself to push for change. He documented his findings and sent report after report to the government enforcement agency. He published brochures that described the shortcomings of poor materials and passed them out to construction workers, engineers and building owners. After several years of committed effort by Hakan, the government started conducting some of its own testing and began to demand that building owners submit material testing reports before they would be issued occupancy permits. Today, Hakan says that 97 percent of the concrete and steel that he tests meets the minimum standards, and a second private testing lab has sprung up to meet the growing market demand.

Some respondents, including those serving in positions such as Head of Disaster Mitigation or Director of School Emergency Management, spend most, or almost all, of their professional time focused on risk reduction. Others in the study, such as a Deputy Mayor or local Community Organizer, spend much less of their time working on risk reduction, although it represents some part of their professional duties. A number of respondents fell somewhere between these two extremes. Although all of the respondents have experience with risk reduction activities in their communities, those who spend much of their time working on risk reduction tend to have educational backgrounds and higher levels of professional training related to risk reduction.

These earthquake practitioners with either "extensive" or more "limited" focus on earthquake risk reduction were included as respondents in this research project. The team acknowledges, however, that other, more traditional earthquake experts, such as seismologists and structural engineers, also play crucial roles in risk reduction. Their work is often a vital input to preparedness or mitigation measures, and they themselves can, and sometimes do, actively advocate for risk reduction in their communities. In most instances, risk reduction measures are undertaken only after leaders—who typically have little or no earthquake expertise—within communities or organizations support those actions. Traditional earthquake experts, earthquake safety practitioners, and community leaders form a spectrum of potential change agents influencing risk reduction in communities and organizations (see Figure 1.3). The roles that these potential change agents play in the earthquake risk reduction cycle are referenced throughout this report.

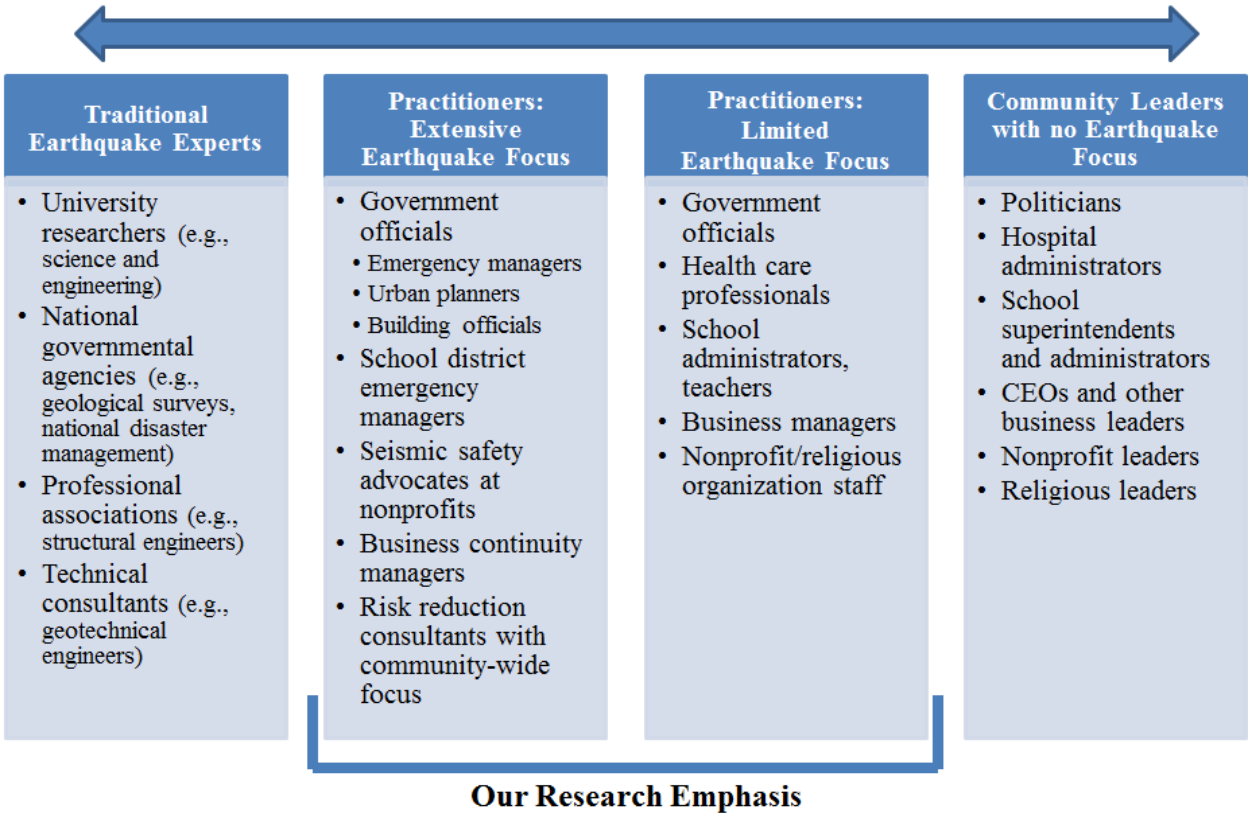


Figure 1.3. Spectrum of Potential Change Agents

During each interview, GHI-CSU team members asked a series of open-ended questions, using a semi-structured interview guide.[23] The interview questions focused on the following topics: (1) professional experience and organizational mission; (2) earthquake risk reduction programs and activities currently underway; (3) tools and resources needed; (4) barriers to implementing risk

[23] See Appendix I for the interview guide in English. Indonesian, Spanish, and Turkish language versions available upon request.

reduction activities; (5) organizational partnerships; and (6) perceptions of risk and vulnerability. The interviews were audio recorded in their entirety and lasted, on average, one hour each.

At the end of the interview, team members gave each respondent a two-page survey questionnaire.[24] After the respondent had filled out the survey, the team asked a series of final follow-up questions, which were designed to gain more detailed information on the closed-ended survey responses. The interview guide and survey instrument were developed drawing upon academic risk communication and disaster risk reduction literatures. The instruments were initially written in English and, where necessary, were translated into the local language, including Indonesian, Spanish, and Turkish. The local partner served as a translator for those interviews that required the survey and oral questions and answers to be conducted in a local language other than English.

All of the audio-recorded interviews were later transcribed verbatim, generating over a thousand pages of textual data. These data were entered into Atlas.ti, a qualitative analysis software package, and coded by three members of the project team. All of the surveys were entered into Microsoft Excel and analyzed using STATA, a statistical analysis program. The findings from the qualitative (interview) and quantitative (survey) data are included in subsequent chapters of this report.

During the field visits, the project team met with five local officials from international development organizations including the World Bank, the United Nations Development Programme (UNDP), and the United Nations Children's Fund (UNICEF). The purpose of these meetings was to introduce the officials to GEM and to explore whether or not these agencies might be interested in using GEM's information in their own risk management activities. These interviews were not audio recorded, but detailed notes were taken about the content of the conversation.

In addition, the GHI-CSU team conducted four interviews to explore how GEM could use so-called "Web 2.0" technologies.[25] Two of these interviews were with Web 2.0 experts, and two were with individuals at the U.S. Geological Survey who have experience using Web 2.0 tools (particularly social media) to communicate scientific information to lay audiences. These interviews were audio recorded, and the recordings were later reviewed to help identify main themes that emerged from the conversations.

This report addresses, in turn, the key programs and activities already in place in the cities that the GHI-CSU team visited (Chapter 2); the resources that respondents said that they needed, in order to understand, communicate, and mitigate earthquake risk more effectively (Chapter 3); and the barriers that the respondents indicated that they face in carrying out their work (Chapter 4). In each section of the report, the team has endeavored to connect the research findings to GEM's mission and goals, while posing key questions regarding how GEM might most effectively communicate and share the important information that it has amassed and will continue to develop in coming years. In addition, the team has placed vignettes, such as the one

[24] See Appendix J for the survey questionnaire in English. Indonesian, Spanish, and Turkish language versions available upon request.
[25] For a description of Web 2.0 technologies, see https://en.wikipedia.org/wiki/Web_2.0.

on page 28 above and the one directly below, throughout the text to highlight the important activities that the respondents in this study are conducting around the world.

Kinley Pem *is the principal of the Lungtenzampa School in Thimphu, Bhutan. She is responsible for the safety of over 1,000 students, teachers, and staff. Kinley explains that the Lungtenzampa building is old and structurally unsafe with dilapidated rooms and not enough exits for everyone to evacuate at the same time. Although structural mitigation will require a much larger budget than what is available, she is working to make immediate changes that will help keep children and teachers safe in the event of an earthquake. Some steps she has taken include fastening the book shelves in the library, rearranging which classrooms are used most frequently, and purchasing a warning siren for the school. The money for these efforts was taken from a small fund generated from student fees.*

Kinley has attended educational workshops about preparedness and mitigation and now holds mock earthquake drills twice a year, involves students and teachers in rescue and evacuation training, invites guest speakers to talk to the students, and posts earthquake information on display boards around the school. "So I must say that we have not gone out of our way to inform the community, because we are surrounded by families," Kinley said. "If we could give the message to our 1,000 students, they are the change agents, so they carry it to the parents, and this is how it goes to the community." The students are encouraged to speak at assemblies about disaster preparedness, raise awareness about safety and hazards in their homes, and attend staff meetings to make suggestions on how the school should be improved. For example, "They made a play on hazards in the house, like suddenly the earthquake comes and they were hit so badly. That was a very good model. So they did that play and then we invited the parents…[the parents] were saying it was very good information for them. They were quite aware now."

Chapter 2 Programs, Resources, and Communication Strategies

This chapter provides an overview of the earthquake risk reduction activities underway in the 11 cities that the GHI-CSU team studied. Specifically, the sections that follow describe earthquake and disaster risk reduction programs and initiatives now in place in these communities; explain what spurred the creation of those programs and initiatives; detail the technical tools and resources that practitioners in these cities currently use to assess and mitigate their risk; describe some key issues that GEM should consider when developing tools or strategies that rely on Web 2.0 technologies; and analyze the communication channels that these professionals now have access to and find most useful in their work. The central goal of this chapter is to provide baseline information about the tools and resources that practitioners already have access to, in order to give GEM a better sense of the contexts in which its products may be evaluated and adopted. This information should also help GEM to assess the "relative advantages" of its potential tools or strategies, compared to what is currently in use in selected earthquake-prone communities around the world.[26]

2.1. Programs and Initiatives

This section summarizes, in table format, the existing programs and initiatives identified by respondents in the 11 target cities. The respondents were selected for inclusion in this study based in part upon their expertise in earthquake preparedness and/or mitigation actions, and Table 2.1 is therefore organized by such activities.[27]

Table 2.1 should be read *vertically.* Each cell in the Mitigation or Preparedness column lists a program or activity described by respondents during the in-depth interviews. There is no relationship across rows in the table.

Three additional features of the table are worth noting: First, when respondents from different target cities reported engaging in the same general activity, then a generic name was used for that activity (e.g., building retrofit programs). Second, when respondents reported engaging in locally-developed programs, then the formal names of those programs were included (e.g., "Map Your Block" preparedness program). Third, when respondents reported that they and their organizations were engaged in regional or national programs and initiatives, then the formal names of those programs and initiatives were included (e.g., "Earthquake and Megacities Initiative" mitigation program), as they clearly influenced local action.

[26] "Relative advantage" is the degree to which an innovation is perceived to be better than the idea that it supersedes. The advantage can be measured in terms of economic savings, levels of social prestige, convenience, satisfaction, and other relevant factors. The "objective" advantage does not necessarily matter; what does matter is whether or not an individual or organization *perceives* the innovation as advantageous. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be. See Everett M. Rogers. 2003. *Diffusion of Innovations.* 5th ed. New York: Free Press.

[27] Many of the respondents in this study also worked on (or worked for organizations that worked on) disaster response and recovery activities. However, given GEM's mission and goals, this chapter focuses on the mitigation and preparedness activities that the practitioners and their organizations were engaged in. Additional data on response and recovery activities is available upon request.

Table 2.1. Earthquake Mitigation and Preparedness Programs

Mitigation	Preparedness
Structural mitigation (building retrofit programs; structural strengthening program; unreinforced masonry removal)	Map Your Block, neighborhood resource mapping programs
Non-structural mitigation (fastening contents in buildings)	Neighborhood Empowerment Network
Enhanced building design	Staff preparedness training
Identification of collapse hazards	CPR training; emergency medical care training; psychological first aid training
Identification of high priority buildings for retrofitting	Public risk education; disaster awareness trainings
Structural assessment program	School-based hazards education
Lifeline protection	School-based emergency drills
Earthquake and Megacities Initiative	Public emergency drills
Environmental conservation programs	Distribution of emergency kits and emergency supplies
Slope stability efforts	Neighborhood capacity, skill, resource mapping
Hazards risk mapping	Disaster Preparedness Teams
Investment planning for mitigation actions	Community organizing for disaster preparedness
Disaster mitigation awareness programs (promoting an understanding of the importance of mitigation)	Safe School Initiatives (school disaster management and evacuation plans)
Population relocation programs (moving persons and businesses out of vulnerable structures and areas)	Emergency training exercises
Micro-zonation maps	Business continuity planning; tabletop exercises and disaster simulations
Planning regulations or policies that incentivize mitigating actions	Disaster volunteer recruitment and training programs
Improved building codes	Parent-child reunification programs
Inventory contents of buildings and homes for insurance purposes, should a disaster occur	First 72 Hours: Are You Prepared? program

Chris Hawker *is the group manager of facilities and operational services for the University of Canterbury in Christchurch, New Zealand. He is in charge of the university's operational needs, including emergency preparedness, and is the primary incident controller when an emergency occurs. Long before the September 2010 and February 2011 earthquakes, Chris was working tirelessly to prepare the university for extreme events.*

In fact, what started as a simple assignment to create a two-page report demonstrating university preparedness levels turned into a serious disaster preparedness campaign led by Chris and his colleague Jackie, the university's risk manager. After researching best practices from universities around the world, they created bulleted preparedness flip-charts and placed them around campus; made preparedness backpacks that contained emergency kits (requiring each staff member and doctoral student to pick one up, so that Chris and Jackie could explain the materials, face-to-face); created an emergency operations center (EOC) in one of the university-owned houses off campus; and wrote a comprehensive disaster preparedness report.

These efforts paid off, as Chris reports: "When we did activate [the plan] on September 4th, it took less than 45 minutes before we had the doors open and the lights on in the operation center, and within two hours we had a fully functioning incident management team on site. And we've grown in our understanding and our ability to apply these lessons ever since...We had certainly done the thinking and it wasn't as much of a shock as it would have been to somebody or an institution that hadn't." Chris and his colleagues have now completed the first volume in a three volume series that outlines the lessons that they have learned and illustrates best practices for preparing for future events.

The mitigation and preparedness efforts outlined above were designed to assist with risk assessment, to encourage physical protection, or to increase response and recovery capacity through pre-event planning. Moreover, each of these programs, listed in Table 2.2, was aimed at assisting and/or engaging one or more levels of social organization, ranging from:

- the *micro* level, which includes individuals and households;
- the *meso* level, which comprises schools, hospitals, businesses, local government, community- and faith-based organizations, neighborhoods, and communities; and
- the *macro* level, which covers regional, national, and international policymaking bodies.[28]

Table 2.2 should be read *vertically.* Each cell in the Micro-, Meso-, or Macro-Level column lists a program target described by respondents during the in-depth interviews. There is no relationship across rows in the table.

[28] Marla Petal. 2007. "Disaster Risk Reduction Education: Material Development, Organization, and Evaluation." *Regional Development Dialogue Journal* 28(2): 1-25.

Table 2.2. Earthquake Mitigation and Preparedness Program Targets

Micro Level	Meso Level	Macro Level
Children	Elementary and secondary schools	Policymakers: advocacy to move toward a "culture of disaster prevention"
Elderly	Colleges and universities	Policymakers: change building code standards
Women; pregnant women	Hospitals	Policymakers: change land-use planning regulations
Adults with disabilities; children with disabilities	Elder care facilities	Policymakers: make preparedness guidelines more socially inclusive
Low-income individuals	Businesses	Policymakers: include the public in mitigation planning decisions
Drug-addicted individuals	Government	
Homeless	Churches, mosques, and other faith-based organizations	
Incarcerated populations	Prisons and jails	
War veterans	Non-profits	
Renters	Media	
Homeowners	Lifelines	
Small business owners		
Non-profit volunteers and staff		
Faith-based leaders; faith-based congregations		
School administrators; teachers		
Government workers		
Health care staff, including doctors, nurses, home health aides, emergency medical technicians, and ambulance drivers		

Understanding the wide array of individuals, groups, and institutions that these programs target is important, because it gives a clearer sense of the reach of the sectors focused on in this study. If GEM is able to collaborate effectively with representatives from these five key sectors, then GEM's platform and associated tools will likely reach a significant portion of any given community.

The practitioners whom the GHI-CSU team interviewed often had limited budgets, but still managed to serve many residents, groups, and organizations in their local communities. One of the primary ways in which they were able to achieve successful programmatic outcomes was through partnering with and/or learning from trusted organizations and individuals, both within their cities and from outside regions. Because practitioners named so many of these trusted organizations and individuals during the in-depth interviews, and because GEM expressed potential interest in reaching out to these organizations and persons, the GHI-CSU team compiled 11 city-specific tables, which include the names of hundreds of trusted organizations and individuals (see Appendix L).

Marnie Kent *(pictured left) and* ***James Young*** *(pictured right) created the Sumner Disaster Response Group after the February 2011 earthquake in Christchurch, New Zealand, voluntarily organizing to address the unmet needs of their neighbors. Marnie and James are both residents of the Sumner community, which is a suburb outside of Christchurch. Their grassroots initiative seeks to assist Sumner community members in preparing for future earthquakes and other disasters.*

When the 6.3 magnitude earthquake shook Christchurch on February 22, 2011, much of the downtown central business district was severely damaged. Disaster response professionals and local resources were directed to the city's center, while suburban areas such as Sumner struggled to recover without much outside support. Marnie quickly realized that something had to be done to help her community, so she reached out to the local fire station to offer support: "The fire station was quite inundated, they needed our help, and they said could we go back to them the next day and see what we could do to assist. We got a call that night to say, 'We're going to open up a hub.' I said, 'Right, let's do it.' We just gathered whatever resources we had in our own homes, paper, pens, whiteboards, and just turned up at the hall and got the hub going, got signage out there, called out for volunteers, gathered numbers of whoever it was we could get, didn't know what was going to happen about civil defense, where are they, what is civil defense, are they a knight in shining armor coming over the hill to rescue us? We didn't know." Marnie led the community hub, gathering resources and information until outside support became available.

When the major aftershock occurred in June, she swung back into action. This second round of earthquake damage was much more devastating to Sumner, even though it was not declared a disaster due to the relatively minor impact on Christchurch. Marnie knew that she could not handle the second response alone, and so she recruited James to step in and open another hub. Their combined efforts have produced major contributions to community preparedness, including a database with: (1) a list of important people and phone numbers, in the event of an emergency; (2) a list of available resources; and (3) a list of vulnerable community members and their needs. Marnie also volunteered to be a street coordinator and went door-to-door gathering people's personal information and their emergency contacts, which she loaded into a private file that could be used in the event of an emergency. Marnie and James created a Facebook page and started a Sumner Community Group website, where people could get information and communicate with one another.

2.2. Program Creation

This section draws on interview data to characterize the primary factors that spurred the creation of many of the programs and initiatives summarized above. Those factors, which are detailed in the following sub-sections, include: (1) occurrence of a disaster; (2) new risk reduction-oriented legislation and regulations; (3) available local/state/national funding; (4) external support and international guidance; and (5) hazards vulnerability concerns, the making of mitigation champions, and strong leadership. The GHI-CSU team views this information on driving forces behind program creation as important, because it may help GEM staff to identify potential points of contact and/or windows of opportunity to integrate GEM tools and products into new or existing programs and initiatives.

2.2.1. Disasters as Precipitating Events

When the team asked practitioners what led to the creation of the programs that they help to coordinate, the most common response given was "a disaster." Most often, the disaster had occurred in the respondents' home cities or nations, and these events were described as a "turning point" or "watershed moment" in their professional careers and organizational histories. The following quotes highlight this finding:

> These activities began with the 1999 Izmit earthquake, because it was a turning point for every sector, and after that, people started to do something to overcome these problems.
>
> ~Health Care Respondent, Antakya

> In 1970, the history of natural disasters would never be the same again: 67,000 dead, 180,000 wounded, 60,000 homes destroyed… It's the black curtain that divides life from misfortune. This is the worst disaster that Peru had ever seen. Two years after that tragedy, in 1972, the Civil Defense system was created.
>
> ~Government Respondent, Lima

> The [2001] Gujarat earthquake was a hallmark, a watershed moment in the preparedness of our own disaster management plans. Several surveys were conducted and Delhi was found to have an equal level of risk.
>
> ~Government Respondent, Delhi

> What provoked organizing ourselves was the [2007 earthquake in Peru]. When the disaster occurred, part of the geographic region was left completely uninhabitable, and building there was no longer possible because of the quality of the soil, it was liquefied soil… So that led us to find a way to resettle and relocate people… so we had to go about creating a system to relocate the impacted people.
>
> ~Government Respondent, Chincha

> In Bhutan, we had a lot of earthquake events in the past, but unfortunately, they have not been documented well… There were a lot of earthquakes with epicenters somewhere near the region, not exactly inside Bhutan, which incurred damage to buildings but not so much to life and property. That was until 2009, the September 21st earthquake, which

> was one of the most devastating earthquakes in our living memory. It caused a lot of lives to be lost, about 5,000 rural homes damaged. So that has really prompted us now. We couldn't possibly take it lightly.
>
> ~Government Respondent, Thimphu

The response that followed the recent series of earthquakes in Christchurch underscores just how quickly organizations can be created and how rapidly change can occur after an event.

> September the 4th, the day of the first earthquake, we stole the mandate. We just took it. We said, "We'll represent the business community." And then we formed a joint venture with the local economic development agency, called Recover Canterbury. Recover Canterbury is a 50-50 joint venture between the Chamber of Commerce and the economic development agency, and it was set up on September 5th, the day after the first earthquake.
>
> ~Business Respondent, Christchurch

Predictably, earthquakes were the most frequently mentioned type of disaster that led to the creation of new risk reduction programs and initiatives. Other events were also influential, however, in many of the cities that the team visited. For example, in Bandung and Padang, respondents spoke of recurring flood losses, volcanic eruptions, and tsunamis as having motivated their program creation and activities. In Christchurch, interviewees discussed how the Severe Acute Respiratory Syndrome (SARS) epidemic, and all of the associated emergency response planning that occurred in New Zealand, also influenced their earthquake preparedness and response planning. In San Francisco, several respondents referenced the 2005 Hurricane Katrina and the September 11, 2001 terrorist attacks as having shaped their professional activities:

> I also [co-chair] the Mayor's Disability Disaster Preparedness Committee, which was a group that formed in the wake of Hurricane Katrina, when people with disabilities were just horrified at how little planning the government and non-profits, including Red Cross, had put into identifying and meeting the needs of people with disabilities.
>
> ~Government Respondent, San Francisco

> Back in [1989], with the Loma Prieta earthquake, we were fortunate, because that happened at 5 o'clock [in the evening], and all the schools were out. But 9/11 happened in the morning time, so we had kids at school, so we had to make some decisions in terms of what you were going to do with these kids. That prompted us to put a parent-child reunification plan in place, because we didn't have anything like that… So after 9/11, we knew we needed to address that particular issue.
>
> ~Education Respondent, San Francisco

Respondents in all of the cities also referred to change that occurred in their organizations and earthquake preparedness activities, as a result of lessons learned from catastrophic events in other countries. Disasters mentioned several times in interviews included the 1988 Armenia earthquake, 1995 Kobe (Japan) earthquake, 2004 Indian Ocean earthquake and tsunami, 2008 Sichuan (China) earthquake, 2009 L'Aquila (Italy) earthquake, 2010 Haiti earthquake, 2010

Chile earthquake, and 2011 Tōhoku (Japan) earthquake. A respondent from the education sector explained how he had changed the earthquake drills at his elementary school, in response to the Tōhoku event:

> After the Japanese earthquake, we actually shifted the length. We usually duck and cover for a minute, and I said, "You know what? Two and a half minutes. Japan shook for two and a half minutes. Let's do two and a half minutes." And after the end of it, the students were like, "That was the longest earthquake drill ever!" And I was like, "That was Japan. Now you know what it's like." And they didn't know why it was so long, but then they heard that and they were like, "Okay, I get it."
>
> ~Education Respondent, San Francisco

2.2.2. Legislation and Regulations

Political scientist Thomas Birkland refers to disasters as "focusing events"—sudden calamities that cause both citizens and policymakers to pay more attention to a public problem and to press for solutions.[29] The most devastating disasters, such as those described above, may result in new public policies, including more stringent building codes and more rigorous disaster management regulations.

Participants in this study described how the earthquakes and other disasters that caused so much destruction in their home cities and surrounding regions led to stricter regulations and, in some cases, more oversight authority for the organizations where they work.

> Since 1999, the earthquake regulations are always being updated, they are always being changed. We have to follow this in our work.
>
> ~Grassroots Respondent, Antakya

> Because the 1999 earthquake was a turning point for all of our country, and after that, the buildings… When a person wants to build new buildings, he or she has to obey the regulations.
>
> ~Government Respondent, Antakya

In Christchurch, some interviewees indicated that they were engaged in earthquake risk assessment activities long before the September 4, 2010 and February 22, 2011 events, which caused so much damage. However, after those earthquakes and associated aftershocks, the work that they were doing became required by law. A Christchurch respondent described this shift:

> Part of that work has also been looking at what's at risk—people, property, infrastructure, things like that. I'm not sure whether you're aware, but we've carried out an engineering lifelines study. That's been going on in Christchurch now for—I think it started about 15 years ago. It was a little bit like what's being done in California and other places as well, the local authorities, the university, local consultants all getting together pretty much on a

[29] Thomas A. Birkland. 1997. *After Disaster: Agenda Setting, Public Policy, and Focusing Events.* Washington, DC: Georgetown University Press.

voluntary basis and initially preparing a report on the risk to infrastructure from a whole range of natural hazards, earthquake obviously being a significant one.

Interviewer: Were they mandated to do that?

No, but we are now, under the new Civil Defense Emergency Management legislation, there is a requirement that structure providers carry out their works. It's obviously based on stuff that came out in the United States earlier, but it's caught on really well here.

~Government Respondent, Christchurch

2.2.3. Local/State/National Funding

Disasters can also lead to an influx of funding[30] dedicated to recovery, reconstruction, and risk reduction activities. In some of the cities that the team visited, this funding was used either to create new programs or to fund existing initiatives more fully.

The Gujarat earthquake was the watershed development. That was when disasters of such magnitude were taken into the planning and budgeting of state governments and the government equally funded all such initiatives.

~Government Respondent, Delhi

This was two days after the [September 4, 2010] earthquake. The Deputy Prime Minister rang me. "How many businesses are affected?" So I said, "2,500." He said, "How much money do you want?" I said, "$15 million." He said, "Okay." So within two days, we had money being pumped into companies, subsidies going to employees… After the [February 22, 2011] earthquake, he rang me again. The employment support subsidy, they made it much more generous because it was a much bigger disaster, February 22nd, it was ten times September 4th… We pumped $200 million into companies over that six-week period. This was an enormous initiative.

~Business Respondent, Christchurch

In the two wealthiest cities in the sample—San Francisco and Christchurch—funding for disaster preparedness and mitigation actions was available on an annual basis, usually through competitive grant competitions sponsored by government agencies or the private sector. This funding, if received, was then used to develop new programs or activities within the respondents' organization, as described by this respondent:

We applied for grants. I've got a grant in right now that we're hoping will come through. And the nice thing about FEMA [the U.S. Federal Emergency Management Agency] is that they're really starting to get it and to prioritize the disaster funding for people with disabilities. Each year they seem to have a theme with the grant cycles, and this year it's about including people with disabilities in the planning process. So hopefully this most recent grant, it's for about $55,000, will come through. If it does, it will allow us to

[30] Funding amounts referenced in this and other sections of the report refer to the respondents' national currency (e.g., New Zealand dollars, U.S. dollars, etc.).

> expand our installation activities into an affordable housing project for formerly homeless and disabled veterans.
>
> ~Government Respondent, San Francisco

In some cases, the grants that these respondents received have been substantial: for instance, in San Francisco, one respondent described a $1 million, ten-year, city-funded effort to translate engineering standards into public policy; another respondent was responsible for a $500,000 grant dedicated to promoting emergency preparedness and to purchasing emergency supplies for schools in the San Francisco Unified School District. But even those with small budgets managed to stretch their funds, in order to develop new programmatic efforts. One faith-based leader elaborated on what he did with the first grant he received:

> I think it was about $1,500. And what I was able to do was train my staff, and that's so very important, because I want them to come to work… But if they're worried about being prepared, worried about where their families are at, they may not come to work and you can't get anything done. So we bought wind-up flashlights for them, we gave them disaster kits to put in their car—so no matter where they are, [if a disaster happens], we made sure that they had all their numbers together, made sure that they knew where everybody was going to be. So doing all those different things, we were able to come up with a real constructive plan.
>
> ~Grassroots Respondent, San Francisco

2.2.4. External Support and International Guidance

Funding for preparedness and risk reduction activities came not only from local and national governments; several respondents from cities in developing countries indicated that they had also received vital monetary support from organizations such as the United Nations Development Programme (UNDP), the United Nations Children's Fund (UNICEF), and the World Bank. This funding allowed the practitioners to create new disaster preparedness and mitigation programs and to implement hazards education efforts, as these respondents from Lima described:

> Since the earthquake in 1996, we have a large program with UNICEF to incorporate risk management in the schools. We've worked on a proposal to improve an educational plan on risk given the experiences of schools in earthquakes and incorporating in the educational curriculum, the topic of risk management. We've done this with the Ministry of Education. There's also an important component of education there, we've developed an official publication on the education of risk management for schools, which we developed in partnership with the education specialists at the Ministry.
>
> ~Grassroots Respondent, Lima

> We have an agreement with UNICEF, which is an agreement between the government and UNICEF. Before, those agreements focused on many themes, such as multiculturalism or basic education. But they never had the theme of risk management. So we created an opportunity in that area, so that with UNICEF we started working for the first time, as part of that cooperative plan that UNICEF has every year, to introduce risk management education, which was launched with some extremely low budgets. But

> since 2009, 2010, 2011, we now have a larger budget for educational materials on the topic of risk management, and it's been growing. Why? Because UNICEF understood that if they're going to address the situation of boys and girls, and the rights that boys and girls have, one of the rights they have is safety, the right to go to school, the right to a secure environment, and also the guarantee of the right to keep studying and going to school, even in an event of an emergency.
>
> ~Education Respondent, Lima

In addition to providing monetary support, the above-named international organizations and other external non-governmental organizations assisted community leaders with creating programs concentrated on capacity development. Save the Children, Plan International, and other major international organizations were especially focused on helping communities to create sustainable, culturally relevant risk reduction programs. In terms of international guidance, numerous respondents in developing countries cited the 2005 Hyogo Framework for Action as critical to conveying the need to undertake new risk reduction actions in the cities where they worked. Two respondents from Lima explained:

> We began to learn that there was this Hyogo Framework for Action agreement that had been signed in 2005. And [it said] that by 2015, the risk of disaster has to be reduced, minimized, in the areas of human, economic, and social losses. Never before could we have prioritized the reduction of risk without the Hyogo Framework for Action because we didn't have the knowledge, no one had given us the skills, no one had trained us. No one had told us that reduction of risk is a priority topic, just like nutrition and health. Because imagine when there's an earthquake, how much money does the central government lose? It loses a lot of money. But they never had the topic of prevention in mind. Because if you start to provide skills and train and prevent, the problem will be less severe as will the risk because at least people will be trained and things won't be as difficult as usual.
>
> ~Grassroots Respondent, Lima

> One of the goals of the Hyogo Framework for Action is to have 100% safe hospitals. So over the last three years of the current government administration, 2009, 2010, 2011, there have been investments made in the health infrastructure like it hasn't been made in the last 30 to 40 years… A national committee has been established on safe hospitals, which is inside the realm of the Ministry of Health. The committee is reaching its second year of operation.
>
> ~Health Care Respondent, Lima

2.2.5 Hazards Vulnerability Concerns, the Making of Mitigation Champions, and the Role of Supportive Leaders

A final theme that emerged in the data is a three-part answer to the question of why new earthquake risk reduction programs were created in the cities that the GHI-CSU team studied. First, an individual or small group of individuals became concerned about the vulnerability of their community to earthquake hazards; second, that person or group then acted on that concern

and became a "mitigation champion"; and third, someone in a leadership position with the authority to help enact change supported the ideas and efforts of the mitigation champion.

What is the origin of the concern that these "mitigation champions" express about their communities' vulnerabilities? Some champions had lived through and responded to disasters themselves:

> Disaster planning has always been close to my heart, because I have been through so many earthquake disasters. I actually lived in the epicenter zone for the 1971 earthquake in Los Angeles. I was living here in San Francisco for '89 and responded [to Loma Prieta] as a city employee as well. So earthquake awareness and preparedness is very close to my heart.
>
> ~Government Respondent, San Francisco

Others had worked on disaster preparedness for different types of events, and eventually came to realize the risks associated with earthquake hazards:

> We were planning for SARS and what that might mean, and what we recognized was that in any natural event, be it an infectious event like pandemic flu or whatever, or a natural disaster, the hospital in Christchurch only has about 500 beds, but in a big event like an earthquake, we realized we might need several thousand beds.
>
> ~Health Care Respondent, Christchurch

Still other respondents became impassioned about disaster preparedness and mitigation, as they learned more about the significant risks that their communities experience:

> Turkey is a very disaster-prone country. Every few years, a flood occurs in certain places and really causes serious damage. And every other few decades, we have serious mass destruction disasters through earthquakes. So once we understood that in this country earthquakes and floods and natural disasters have a serious history, we sat down again and said, "Okay, we are going to form a voluntary search and rescue team that will work without anything in return, fully voluntary, as a charity, and we want to do this for mountaineering accidents, wilderness accidents, outdoor sports accidents. But then we said, "Why keep it only limited to the wilderness?" If we are going to organize such a voluntary team, let's use it for floods and big earthquakes and like that, if needs come up.
>
> ~Grassroots Respondent, Istanbul

As the quote above demonstrates, the practitioners in this study often progressed from a place of concern to one of action. Indeed, another respondent described how seeing the number of dead in consecutive natural disasters—and knowing that the losses could have been averted—prompted him and his colleagues to return to Delhi and increase their efforts to provide safe and sustainable housing that could withstand a disaster:

> We are trained as architects, planners, as you know. Our initial experience was in carrying out humanitarian activities, response and relief activities, for people who were getting affected by these disasters. There was the earthquake in 1999 in Turkey. Similar

> such incidents included a cyclone in Gujarat in 1998. So we were like volunteers, we were just going through to distribute relief materials, to help out other big organizations who were actually carrying out such operations. And when we were doing that, we realized that so many lives were lost because of simple things that people could have done. And a lot of that has to do with the level of technical knowledge. Somewhere there was this burning flame… I think our mission should be to bridge that knowledge gap. So we have at one end the best knowledge institutions in the world, but at the other end people are dying because they don't know simple things to do that can save their lives. So that was one major spark that led to the creation of this organization.
>
> ~Grassroots Respondent, Delhi

While extremely dedicated, these mitigation champions often needed the support of a leader with the authority to implement and fund initiatives designed to produce tangible, lasting change. This point was evident in the narrative offered by a respondent from Christchurch, who was quoted earlier. He continued:

> On September 6th, the Monday after the September 4th earthquake, I went on national radio. The city was closed down. The central business district was closed off. I said, "We have to do something to protect the businesses in our community, because there is no cash flow…" The Deputy Prime Minister heard me on the radio and he rang me and he said, "I've just heard you on the radio. I agree with every word that you've said. What do you want us to do?"
>
> ~Business Respondent, Christchurch

A business leader from Lima emphasized the important role that government officials and representatives from the Red Cross have played in helping to keep individuals in the business sector "permanently motivated" in the area of earthquake risk reduction:

> So trying to keep us permanently motivated, that is something the government officials helped us on a lot, the Red Cross too. They helped us to reignite certain trainings and to help us understand what is happening in other places. To keep us motivated, to help us understand how what we are doing can apply here, all of this helps a lot.
>
> ~Business Respondent, Lima

2.3. Technical Resources

In order to understand the risk that their cities faced, the practitioners in this study used a variety of technical resources amassed from many sources. Table 2.3 (which spans four pages) summarizes the technical resources by city and by sector. (Section 3.1, in Chapter 3, contains information about the specific types of earthquake risk information, such as projected economic losses, that practitioners already have as well as those they reportedly need.)

To read Table 2.3, readers should begin by looking at the far-left column. This column includes a cell for each of the 11 target cities. When read *horizontally*, the table's data show the technical resources that were used by practitioners within a particular city.

The five sectors (e.g., government, business, health care, education, and grassroots) are listed across the top row of the table. To understand what technical resources respondents from a particular sector relied upon, readers should scan the table *vertically.*

The qualitative data summarized in Table 2.3 suggest the following important patterns.

First, the overwhelming majority of practitioners interviewed in this study acquired technical information regarding earthquake risk (including information on hazards exposure and physical and social vulnerability) from secondary sources. Practitioners found this information online or in technical reports that their organizations (or other organizations in their city) commissioned.

Second, the small number (i.e., <10) of more technically sophisticated practitioners collected primary data from various sources (e.g., Hazus™, U.S. Geological Survey, city-level building inventories, etc.), in order to generate their own "risk profiles" for their organizations and the cities that they serve. This was a technically difficult and time-consuming process to undertake. Moreover, many respondents lack access to even the most basic information that they would need to generate such a risk profile (see Chapter 3 and Chapter 4 for more detailed discussion of resource needs and barriers to earthquake risk reduction).

The most consistent finding across all 11 cities was that respondents lacked one central tool that could provide a comprehensive portrait of earthquake risk in their cities. Instead, practitioners attempted to draw together technical resources from different sources to get some sense of the potential impacts of an earthquake on their city's lifelines, critical infrastructure, and population groups.

Table 2.3. Technical Resources by City and by Sector (continues on next three pages)

	Government	Business	Health Care	Education	Grassroots
Antakya, Turkey	Internet; reports and technical documents; geophysical mapping	Internet; reports and technical documents; municipality directives; sample tests of building materials; factory machine testing of materials; Ministry of Industry regulations; building code legislation	Internet; reports and technical documents	Internet; reports and technical documents; animated documentaries about natural disasters	Internet; reports and technical documents
Bandung, Indonesia	Internet; zoning maps	Internet; reports and technical documents; earthquake maps	Internet; reports and technical documents; ambulance data; building code legislation	Internet; reports and technical documents; movies and documentaries about natural disaster; building photographs	Internet; reports and technical documents; scientific and non-scientific presentations; ground and groundwater survey reports; seismicity lectures; movies; seismometers; building regulations and inspections; Seramar project (comparing new and old building safety)
Chincha, Peru	Internet; reports and technical documents; micro-zonation studies; census data	Internet; reports and technical documents; AutoCAD	Internet; reports and technical documents; hospital structural vulnerability studies	Internet; reports and technical documents; NGO visits and lectures; Civil Defense trainings; Ministry of Education pamphlets	Internet; books, reports, and technical documents; post-earthquake impact data; visual assessment of earthquake damage; earthquake science professionals
Christchurch, New Zealand	Internet; reports and technical documents; policy review boards; community-wide structural integrity assessment database; geological assessments; scenario modeling; engineering surveys	Internet; reports and technical documents; city planning models; GeoNet land surveys	Internet; reports and technical documents	Internet; reports and technical documents; preparedness templates; seismic assessments; historical seismic reports; geotechnical assessments; geographic information systems (GIS)	Internet; reports and technical documents; community resources database; Civil Defense manuals and trainings

Table 2.3. Technical Resources by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Delhi, India	Internet; reports and technical documents; geographic information systems (GIS); Global Positioning Systems (GPS); remote sensing; Google Earth™; early warning systems; visual private networking; earthquake zonation maps	Internet; reports and technical documents; internally generated database of fragility curves for buildings and infrastructure; earthquake zonation maps	Internet; reports and technical documents	Internet; reports and technical documents	Internet; reports and technical documents
Istanbul, Turkey	Internet; reports and technical documents; video surveillance; geological maps; urban transformation studies; legal tools; ground and soil analysis tools/earth science data; Earthquake and Megacity Initiative; Urban Seismic Risk Index; Coping Capacity Index; Disaster Risk Management Index	Internet; reports and technical documents; public opinion research reports/ market research; vibration isolators; seismic isolators; seismic bracings; national and international building code standards; insurance company protocols; in-house risk assessments and modeling; early loss assessment tools; aerial devices to identify damage and losses; earthquake maps; earthquake awareness and education trucks; earthquake simulators to demonstrate what to do during an earthquake as well as the importance of non-structural mitigation	Internet; reports and technical documents; emergency preparedness plans; Istanbul Disaster Health Plan	Internet; reports and technical documents; school training assessment reports; contingency plans; maps; online interactive education; public opinion questionnaires; Federal Emergency Management Agency (FEMA) documents and data; Disaster Risk Educational Materials Content Management System (DREAMS) program information	Internet; books, reports, and technical documents; training documents and movies; Istanbul Earthquake Master Plan;

Table 2.3. Technical Resources by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Lima, Peru	Internet; reports and technical documents; census data; technical safety inspection data; thematic mapping	Internet; reports and technical documents; National Risk Management System; evacuation safe zones maps; maps of seismic fault lines; reliance on maps where gasoline fillings are located; maps from the Geophysics Institute	Internet; reports and technical documents; Ministry of Health and Civil Defense alerts/warnings; risk assessment analyses and evaluations; safe zone analyses; earthquake photo and video simulations; vulnerability studies in hospitals	Internet; reports and technical documents; maps; training materials; national maps of high risk zones; disaster preparedness materials and websites; risk maps; city vulnerability, micro-zoning, and earthquake risk studies; geo-spatial database	Internet; reports and technical documents; Civil Defense social and scientific risk reports; seismic micro-sonographic and vulnerability studies; governmental manuals; safe zones and soil maps; data on housing, hospital and school construction conditions
Padang, Indonesia	Internet; reports and technical documents	Internet; reports and technical documents	Internet; reports and technical documents	Internet; reports and technical documents	Internet; reports and technical documents
San Francisco, USA	Internet; reports and technical documents; Hazus-US™; USGS data; NOAA data; census data; California Standardized Emergency Management System (SEMS) information; U.S. National Incident Management System (NIMS) guidance; GIS; city-wide building inventories; Map Your Block resources; industry and education online forums; university symposiums and research reports; local government data; state government data; Compressed Air Foam Systems reports; FEMA research	Internet; reports and technical documents; Hazus-US™; USGS data and shake maps; GIS; NOAA data; city-wide infrastructure inventories; business risk assessment reports; internal building inventories; FEMA reports; disaster expert email listservs	Internet; reports and technical documents; county-wide on-call systems; tabletop exercises; all-hazards staffing contingency plans; evacuation contingency plans; maps; nationwide hospital questionnaire	Internet; reports and technical documents; emergency operation plan; earthquake curriculum; radios for cross-site communication; analogue phones; faculty survey data;	Internet; reports and technical documents; disaster-focused websites with real-time information;

Table 2.3. Technical Resources by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Thimphu, Bhutan	Internet; reports and technical documents; earthquake zonation maps; disaster management information system; documentaries of earthquakes and floods	Internet; reports and technical documents	Internet; reports and technical documents	Internet; reports and technical documents	Internet; reports and technical documents

Note: Guwahati, India is not included in Table 2.3 because the practitioner interviews in that city were not audio recorded.

2.4. Communication Channels and Technologies

The GHI-CSU team asked a series of closed-ended survey questions about how respondents prefer to receive and share information for professional purposes; the goal was to inform GEM about the communication channels that respondents in the target cities find most useful. The final survey included 13 questions[31] that asked respondents to specify whether the following items or activities were of "low," "medium," or "high" usefulness for professional purposes; "not available"; or "available, but not useful":

- Newspapers;
- Radio;
- Television;
- Social media (such as Facebook, Twitter);
- Scientific publications (such as books, journal articles, trade magazines);
- Email;
- Telephone;
- Talking in person with community members;
- Talking in person with scientific experts;
- General news websites;
- Government websites;
- Earthquake- or disaster-focused websites;
- Earthquake hazard maps.

Table 2.4 summarizes response counts and percentages across all 119 survey respondents for each of these 13 communication-related items. The table is organized so that the modes of receiving and sharing information that were rated as most highly useful (see right column) are at the top of the table, while those that were rated as least useful appear at the bottom of the table. Talking with community members and earthquake-focused websites received the most "highly useful" responses, and conversely, government websites and social media received the least "highly useful" responses.

A promising finding shown in Table 2.4 is that few respondents rated any of the communication channels as "not useful" or "not available." That result suggests that GEM would probably be able to reach earthquake safety practitioners in various geographic regions through a variety of communication channels.

[31] See Appendix J for the complete survey questionnaire.

Table 2.4. Availability and Usefulness of Communication Channels for Receiving and Sharing Information

Source	Not Available		Not Useful		Low		Medium		High	
	Count (n)	Percentage (%)	Count (n)	Percentage (%)	Count (n)	Percentage (%)	Count (n)	Percentage (%)	Count (n)	Percentage (%)
Talking w/ community members	-	-	-	-	10	9%	36	31%	72	61%
Earthquake-focused websites	2	2%	1	1%	15	13%	29	25%	70	60%
Email	1	1%	2	2%	22	19%	25	22%	65	57%
Talking w/ scientific experts	12	10%	-	-	16	14%	26	22%	62	54%
Television	2	2%	4	3%	13	11%	36	31%	62	53%
Earthquake hazard maps	8	7%	3	3%	16	14%	28	24%	60	52%
Scientific publications	5	5%	1	1%	22	20%	37	33%	47	42%
News websites	2	2%	1	1%	24	21%	41	35%	48	41%
Telephone	3	3%	4	4%	28	25%	31	28%	46	41%
Radio	1	1%	5	4%	43	36%	26	22%	44	37%
Newspapers	1	1%	4	3%	25	21%	44	38%	43	37%
Social Media	5	4%	6	5%	35	30%	39	33%	33	28%
Government websites	3	3%	2	2%	32	28%	46	40%	32	28%

Note: Although 119 individuals completed the survey, the counts do not always total 119, because some individuals did not answer all of the survey items.
Note: Percentages reflect rounded estimates and may not sum to 100 percent.

To summarize and more fully compare the usefulness of the 13 communication channels that the survey assessed, the team created a rank-order scale and assigned the following numbers to the relevant survey responses: "not useful" (1), "low" (2), "medium" (3), and "high" (4) (see Figure 2.1).

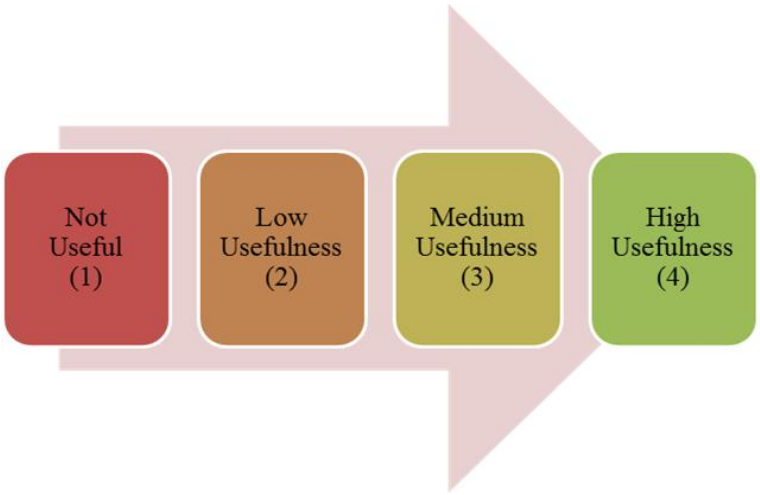


Figure 2.1. Communication Channel Usefulness Scale

Table 2.5 shows the average score on the scale for each communication item. Higher scores indicate that the resource is, on average, perceived as more useful than the other sources of professional information. Because the scale only ranges from 1 to 4, the averages appear rather tightly clustered. However, they indicate important differences in the perceived usefulness of different communication channels. For example, talking with community members, perceived as the most useful, has an average score of 3.51, which falls between medium- and high-perceived usefulness on the scale. In comparison, the 2.87 average score for social media, perceived as the least useful from this group, indicates that respondents perceive it as having between low and medium usefulness.[32]

[32] It is unclear why social media was ranked lower than other communication channels included in the survey. The team believes that the average age of respondents, and the fact that it is difficult to convey complex mitigation and preparedness information via social media, are factors that may contribute to this trend.

Table 2.5. Average Usefulness of Communication Channels

Source	Average Usefulness
Talking in person with community members	3.51
Earthquake- or disaster-focused websites	3.46
Talking in person with scientific experts	3.43
Earthquake hazard maps	3.36
Television	3.36
Email	3.34
Scientific publications (such as books, journal articles, etc.)	3.22
General news websites	3.19
Telephone	3.09
Newspapers	3.09
Government websites	2.96
Radio	2.92
Social media (such as Facebook, Twitter, etc.)	2.87

B. K. Sharma *is the principal at the Ludlow Castle School in Delhi, India. He is actively dedicated to making his school the "best school in India" in terms of earthquake preparedness. After witnessing the destruction caused by the earthquake in Gujarat and realizing that his school was in a high-hazard zone, he began taking steps to prepare students and their parents for an earthquake.*

B. K. Sharma's efforts include student trainings and monthly earthquake drills in the schools. Ludlow Castle School was also retrofitted as part of a GeoHazards International's USAID-funded project. When asked why he is so passionate about educating students about earthquake mitigation and preparedness, he replied, "People say that when you teach a boy, you teach a single person. If you teach a girl, you teach a family. Similarly, I think if I teach a teacher, I teach the class. If I teach a student, then I teach the family of the student, also. So by giving information to the students, particular knowledge to the students, I am preparing the society for this event."

B. K. Sharma recommends that people attend workshops to gain practical knowledge. He explains, "Initially people don't like to take interest in this, but when they attend the workshop, they get very much interested in it, and they want to know how much experience is needed to mitigate their houses. And when we give them information on how they can get themselves prepared for the earthquake, they are surprised… They want to know the safety measures, and these safety measures are not very costly. If they have the information, the knowledge, they can do it themselves."

GEM and Web 2.0

The GHI-CSU project team conducted four interviews to explore how Web 2.0 technologies could be used by GEM. Two interviews were with Web 2.0 experts and two were with individuals at the U.S. Geological Survey who have experience using Web 2.0 tools, particularly social media, to communicate scientific information to lay audiences. The three key takeaways from those interviews are:

- **The goals of an initiative should drive the use of Web 2.0 technologies, not the other way around.** Organizations should not spend time and resources developing Web 2.0 tools unless the tools will help achieve one or more of the organization's goals.

- **Web 2.0 can be an effective tool to engage a community of people around a clear, common purpose.** Web 2.0 technologies provide a medium for users to be consumers *and* contributors of information, effectively becoming participants in a process rather than passive bystanders. But in order to attract users to contribute information to an initiative, the initiative's purpose and benefits must be clear. Google Map Maker is an example, which GEM could learn from, of the potential of Web 2.0 to engage a geographically diverse group of users. Map Maker users are able to add to and update maps that visitors to Google's website see in Google Maps and Google Earth™. A majority of the information displayed in Google Maps about Sub-Saharan Africa and India has come from volunteers. According to Google Geospatial Technologist Ed Parsons, these Map Maker participants volunteer their time uploading data to Map Maker because they believe the maps will bring social or economic benefits to Africa or India, such as by helping governments to be more effective or by providing platforms for businesses to advertise.

- **Web 2.0 has its risks.** Web 2.0 technologies allow organizations to communicate with large numbers of people at low cost. But this benefit has its risks. People can post comments with inaccurate information on an organization's website or social media page that reflects badly on the host organization. The U.S. Geological Survey (USGS), for example, has had individuals' earthquake predictions on its Facebook page. The USGS fears that this false information could be legitimized because it appears on the USGS Facebook page, even when the comments are clearly from a source other than the USGS. At the same time, visitors to the USGS Facebook site often ask smart questions and expect smart responses. By responding, the USGS believes it has strengthened its relationship with the public. But committing to answer questions has led to another risk: the volume of questions can sometimes outstrip the USGS's ability to respond in a timely manner.

2.5. Communication and Outreach Activities

The practitioners who participated in this study communicated with and conducted outreach to the various community members and groups that they served in numerous ways, including disaster simulations, workshops, trainings, educational classes, and more. Table 2.6 (which spans nine pages) summarizes these activities. This information included in this table demonstrates the wide-range of activities that the practitioners are engaged in, as well as underscores the ongoing need for new and innovative ways to communicate with a variety of "publics" that these practitioners serve.

To read Table 2.6, readers should begin by looking at the far-left column. This column includes a cell for each of the 11 target cities. When read *horizontally*, the table's data show the activities that practitioners engaged in within a particular city.

The five sectors (e.g., government, business, health care, education, and grassroots) are listed across the top row of the table. To understand which activities respondents from a particular sector sponsored, readers should scan the table *vertically.*

Table 2.6. Communication and Outreach Activities by City and by Sector (continues on next eight pages)

	Government	Business	Health Care	Education	Grassroots
Antakya, Turkey	Collaborating with other government agencies and disaster professionals; sponsoring and participating in training and seminar programs; hosting a natural disaster preparedness website; passing legislation to encourage disaster preparedness and mitigation; providing incentives to retrofit or strengthen buildings; assessing and retrofitting buildings; championing a seismicity project	Collaborating and information sharing with universities, government, NATO, etc.; supporting private sector workers in disaster preparedness; sharing information through newspaper advertisements, Internet, lectures, reports, conferences, seminars, meetings, and reports; distributing technical documents and links to websites; distributing preparedness questionnaires; sponsoring retrofitting projects; supporting businesses to comply with building regulations; training employees to test building materials; hosting festivals; lobbying for quality control testing and legal standards on building materials; attending seminars and conferences	Sponsoring disaster drills and training activities; collaborating with mitigation experts; training hospital staff in emergency response; writing disaster contingency plans	Developing earthquake education programs; sponsoring evacuation and rescue drills; holding disaster response workshops for teachers and students; assessing and retrofitting schools; forming school response brigades; offering demonstrations of rescue and response operations for schools; developing websites with natural disaster information	Sponsoring seminars and presentations by visiting professors for local government and the public; disseminating preparedness information via newspapers and social media; holding disaster drills and simulations; sponsoring building assessment, retrofitting, and restoration projects

Table 2.6. Communication and Outreach Activities by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Bandung, Indonesia	Engaging in research collaborations; sharing information through radio, talk shows, email, etc.; hosting disaster risk reduction trainings; developing preparedness videos; hosting "train the trainers" programs; engaging with local media; developing disaster simulations; advocating for policy change	Designing and implementing employee preparedness trainings; holding disaster drills and simulations; engaging in cross-sector collaborations; hosting preparedness websites	Organizing and sponsoring conferences for health care and medical response professionals; compiling medical equipment inventories; collaborating with preparedness experts; holding disaster drills and simulations; updating best practices documents; developing a natural disaster emergency plan	Holding disaster drills and simulations; sharing information through presentations, PowerPoint™, movies, Internet, cartoons, animations, etc.; collaborating across sectors; assessing and retrofitting schools; sponsoring teacher rescue teams; developing school evacuation instructions and emergency plans; hosting expert presentations; conducting building analyses	Teaching first aid; Developing mitigation and preparedness documents; Retrofitting homes and historical structures; sharing information through television, presentations, workshops, reports, lectures, social media; movies, PowerPoint™, news articles, websites, etc.; collaborating across sectors; sponsoring public disaster education and mitigation campaigns
Chincha, Peru	Developing disaster simulations; giving guest lectures in schools; forming public response brigades; assembling and distributing first aid kits to encourage preparedness; designing preparedness banners; collaborating with technical experts in risk management; distributing bulletins, risk maps, etc. for public education campaigns	Holding disaster drills and simulations; leading post-earthquake school-based education programs; offering internships in schools; training groups in risk assessment; identifying emergency evacuation routes	Holding disaster drills and simulations; creating hospital emergency contingency plans; forming hospital response brigades; developing hospital evacuation plans; training hospital workers in emergency response	Identifying emergency evacuation routes in different situations (e.g., rural versus urban); offering lectures and tutorials; holding disaster drills and simulations; participating in public brigades	Giving talks and holding workshops; offering psychological support; sponsoring programs for women; developing micro-enterprise; organizing reconstruction investigation brigades; developing disaster simulations; identifying safety zones, evacuation routes, and risk areas for schools; constructing safe schools; retrofitting buildings; writing scientific publications; creating competencies for construction projects; collaborating across sectors

Table 2.6. Communication and Outreach Activities by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Christchurch, New Zealand	Distributing educational materials; hosting community educational forums; convening land-use policy review boards; engaging in joint infrastructure planning; educating vested business interests; conducting community preparedness assessments; engaging in strategic response development planning; developing community advisory centers; hosting public meetings; developing national awareness campaigns; disseminating information through social media; designing preparedness campaigns	Conducting outreach through Internet, direct email to business owners, face-to-face meetings, etc.; assembling a cooperative of business groups; creating a central business database; opening a business call center; communicating through Facebook/social media, text messaging, direct phone calls, etc.; studying international best practices	Holding hospital emergency training exercises; teaching about the emergency management structure and emergency incident coordination; creating an emergency management information system; supporting local disaster response; assessing resource availability; identifying emergency operations centers and mobile healthcare units; sponsoring local emergency preparedness groups; studying international best practices; sponsoring disaster preparedness education for health care professionals	Creating a coordinated incident management system; developing emergency preparedness programs for schools; implementing text messaging preparedness and alert systems; establishing emergency response centers, organizing community emergency response teams; forming committees of school principals, education stakeholders, social service agencies, NGO's, etc.; developing disaster simulations	Distributing education flyers, newsletters, etc.; holding workshops; engaging in door-to-door preparedness campaigns; holding community meetings; engaging in advocacy; holding regular meetings with city officials; issuing reports; communicating with the public through email, websites, social media, etc.; hosting a community notice board, messaging system, and resource hubs; collaborating across sectors; distributing resource packets; compiling lists of vulnerable populations

Table 2.6. Communication and Outreach Activities by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Delhi, India	Hosting workshops and offering training programs for the public, other government officials, schools, hospitals, the private sector, etc.; disseminating preparedness materials; encouraging the creation of family disaster preparedness plans; conducting emergency drills; offering "blended learning" with a combination of face-to-face and online training; involving college students in inventorying buildings; passing legislation to encourage disaster preparedness and mitigation; building capacity among NGOs	Offering multi-hazard training programs for industry; completing damage and economic loss assessments for clients; using loss information to advocate for governmental mitigation activities; speaking at public events about risk assessment; engaging in public outreach; leading walkthrough events with media to raise awareness of vulnerable structures	Collaborating with the media to raise risk awareness; collaborating across sectors; conducting outreach to patients and visitors in hospitals through television programs, pamphlets, etc.; sponsoring "train the trainers" programs, staff training programs, etc.; sharing best practices through email lists, national conferences, etc.	Sharing disaster preparedness pamphlets with parents; involving children in community-wide door-to-door preparedness campaigns; assembling earthquake safety kits; staging mock earthquake drills; engaging children in risk mapping exercises; receiving training in emergency response and search and rescue; training teachers in earthquake awareness; encouraging media coverage of school events; working with experts to make school buildings earthquake resistant; advocating for policy changes for safer schools; teaching children and parents about non-structural mitigation activities	Working with "change agents" in the community (teachers, leaders, etc.) to translate and communicate earthquake preparedness information; hosting public workshops and seminars; engaging in peer-learning activities; preparing buildings to prevent falling hazards in earthquakes; organizing public rallies on earthquake safety; holding workshops in schools; helping to pre-position food and other emergency supplies; leading first-aid and fire safety programs; training teachers to do basic search and rescue after an event; providing emergency kits and relief supplies to the public

Table 2.6. Communication and Outreach Activities by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Istanbul, Turkey	Participating in educational conferences and seminars; communicating with the public through radio, television, public advertisements, etc.; offering free preparedness training courses specific to different types of risks; coordinating meetings between government leaders and the public; networking with academic institutions	Providing incentives for non-structural mitigation; informing businesses about non-structural mitigation tools; providing free services to raise awareness about importance of non-structural mitigation; holding seminars; publishing papers, books, etc.; volunteering; giving presentations; engaging in cross-organizational interviews and meetings; hosting workshops for insurance adjusters, business owners, etc.; fostering relationships and facilitating the organizational and coordination capacity of private companies; engaging in public relations activities; advocating for policy change; designing trucks able to travel over fault lines; raising awareness about seismic risk among those living in vulnerable locations; developing earthquake simulators; providing incentives for increased insurance uptake	Hosting training courses, presentations, etc. for hospitals; holding disaster drills and simulations; developing earthquake scenarios; collaborating with academics; creating "lessons learned" documents based on past earthquakes; updating communication strategies; engaging in outreach to schools; educating special needs populations; sponsoring TV advertisements, billboards, etc.; participating in a network of disaster risk reduction professionals; encouraging international cooperation; developing educational documents	Educating students, teachers, and parents about disaster risk reduction activities and proper response actions; showing movies and other educational documentaries; training school administrators, directors of schools, teachers, and students about building protection and civil protection; using simulation centers to train employees and students about earthquakes; holding disaster drills; offering free first aid training; sponsoring "Earthquake Week" activities at all provincial schools; teaching teachers how to implement non-structural mitigation techniques in the classroom; attending conferences; distributing educational booklets, posters, etc.; hosting e-learning modules through websites; communicating with children and families through Twitter, Facebook, email, Google+, etc.	Encouraging media coverage of hazards risk; offering first aid training; offering specialty training sessions (e.g., mountaineering, earthquake rescue, flood rescue, etc.); sponsoring presentations, seminars, training movies, etc.; distributing booklets and other educational materials; hosting theater shows to educate the public; enlisting celebrities to enhance earthquake awareness; placing safety instructions in vehicles; communicating with the public through Internet, Facebook; Twitter, email, etc.; developing collaborative partnerships; enlisting volunteers; holding disaster drills and simulations; sponsoring "train the trainers" programs; offering school and public presentations; establishing telephone call chains; sharing preparedness best practices

Table 2.6. Communication and Outreach Activities by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Lima, Peru	Collaborating with other government offices and external partners; developing urban development and security strategies; implementing housing assistance systems; coordinating assistance for vulnerable groups and sectors; developing urban revitalization plans; implementing renovation projects; implementing emergency intervention plans; offering skills training workshops; engaging in public dialogues; developing disaster contingency plans; distributing disaster preparedness backpacks to teachers; hosting disaster simulations; working with college students, professors, and industrial sectors; completing soil testing and studies with engineers; conducting outreach using reports, radios, audio/visual systems, etc.; creating disaster education CD's	Hosting evacuation simulations; developing risk response strategies; collaborating with local government to supply disaster preparedness information and technical assistance to businesses; offering exchange programs with other institutions; creating emergency plans; establishing business networks to address disasters and emergencies; collaborating with government agencies, business councils, and NGOs; creating individual and family preparedness backpacks; participating in disaster risk reduction programs and workshops; working with the Red Cross to introduce disaster and emergency work to businesses; offering insurance programs for earthquakes; holding disaster response trainings; communicating through Facebook, presentations, conferences, etc.	Establishing disaster committees; identifying refuge zones and evacuation routes; holding disaster drills and simulations; collaborating with government, NGOs, etc.; developing emergency contingency plans; working with engineers to create safety zones in hospitals; offering disaster preparedness activities and talks; establishing disaster assessment teams; offering earthquake prevention programs; incorporating environmental and earthquake risk into educational curriculum; developing mitigation plans, flyers, brochures, etc.; designing safe hospitals; prioritizing technical assistance in areas of high seismic activity; receiving and providing technical assistance; developing regional preparedness committees; assisting vulnerable populations; developing virtual information systems; investing in health infrastructure	Planning risk assessment and management activities; collaborating with government, NGOs, etc.; incorporating disaster risk assessment and management in school curriculum; developing risk management and contingency plans; sponsoring emergency preparedness simulations, trainings, and workshops; creating risk assessment commissions; training educational directors; reaching out to specialists that develop and implement disaster plans; creating safe zones; producing micro-zonation, danger/risk, and vulnerability maps; creating and implementing strategies to address earthquake risk in schools; convening meetings of teachers, school administrators, and students; providing technical information on websites	Collaborating with the public and private sectors for disaster preparedness projects; carrying out public education campaigns; providing safe building materials; developing disaster preparedness projects and trainings; writing reports; creating local risk mitigation development programs and risk management tools; implementing participatory workshops in communities; holding disaster simulations; promoting local meetings and empowering communities; offering internship opportunities; implementing risk reduction development plans and corrective programs; improving housing construction; relocating rural populations to safer areas; improving earthquake education efforts; developing risk management networks; sponsoring disaster prevention initiatives; building schools and safe structures; creating maps of vulnerable areas

Table 2.6. Communication and Outreach Activities by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
Padang, Indonesia	Encouraging and enforcing structural mitigation activities; sponsoring earthquake preparedness drills and tabletop exercises; establishing shelter sites; identifying evacuation routes; issuing permits to build only earthquake resistant structures; supervising building projects; developing disaster preparedness curriculum for schools; engaging in media outreach to raise earthquake risk awareness	Developing programs and procedures to encourage earthquake safety in the private sector; holding disaster drills and simulations; inviting technical experts to speak on earthquake mitigation and preparedness; working with local schools on disaster risk reduction programs; hosting video competitions to encourage creative simulations; providing free Internet training to the public and using earthquake-focused websites during the sessions	Preparing for public health emergencies in the event of a disaster; training hospital staff in earthquake preparedness	Teaching key tenets of disaster risk reduction to school children; teaching students how to use emergency radios; making evacuation maps; holding disaster drills and simulations; hosting teacher training sessions on disaster risk reduction educational activities; providing students with earthquake preparedness and mitigation materials to give to their parents; advocating for stricter governmental policies requiring earthquake preparedness and mitigation activities in schools; forming school disaster preparedness teams	Advocating for "good governance" in terms of disaster risk reduction activities; conducting hazard, vulnerability, and capacity assessments; forming disaster preparedness teams in communities; empowering and organizing community members for social change; building capacity among school personnel and students in hazard-prone areas; working with journalists to accurately communicate hazards information

Table 2.6. Communication and Outreach Activities by City and by Sector (continued)

	Government	Business	Health Care	Education	Grassroots
San Francisco, USA (continues on next page)	Encouraging individual and family preparedness plan development; developing websites for disseminating preparedness information; developing preparedness quizzes for individuals; developing preparedness communication strategies for broadcast media; developing iPhone app for individuals to report and compete in preparedness activities; developing communication materials in different languages; engaging in media outreach; giving in-person presentations across sectors and to neighborhood associations and churches; supporting disaster preparedness in existing neighborhood programs; assisting in the development of business continuity plans; working in disaster-related committees with other government agencies; disseminating earthquake kits to vulnerable populations; developing bond initiatives for	Giving presentations to non-profit organizations, businesses, and government agencies; writing preparedness, response, and recovery plans for internal departments and corporate affiliates; holding tabletop exercises; sponsoring preparedness and response training with employees; completing building inspections of corporate facilities; sponsoring training events with disaster organization for employees; disseminating individual and family preparedness materials; holding emergency exercises; conducting preparedness audits; distributing personal preparedness quizzes; hosting webinars for executives; raffling earthquake kits; issuing individual and family preparedness reminders in staff meetings; participating in corporate risk management programs; hiring engineering consultants	Participating in city-wide earthquake drills; offering post-disaster supportive health services; collaborating with community members, local government, other hospitals, private sector and non-profit organizations, federal agencies, etc.; participating in Incident Command training programs; sharing information through presentations, Internet, intranet, manuals, listservs, email, etc.; convening monthly hospital preparedness meetings; coordinating county-wide on-call systems; holding tabletop exercises; leading individual and family preparedness trainings, special needs preparedness trainings, etc.; designing all-hazards staffing contingency plans; requiring disaster coursework for all hospital personnel; participating in a multidisciplinary disaster committee and related	Working with early childhood development centers; creating emergency operations plans; collaborating and information sharing with government, other schools, neighborhood associations, businesses, hospitals, emergency responders, etc.; sharing information through email, websites, technical documents, school newsletters, conferences, etc.; participating in the annual statewide earthquake drill (Great California Shakeout); developing parent-child reunification plans; participating in city meetings; attending offsite training sessions; implementing earthquake education curriculum; offering educational credit for earthquake knowledge demonstrated in classrooms; holding school meetings to discuss emergency planning; participating in parent-teacher association meetings; holding teacher training sessions; purchasing radios for cross-site	Tracking and recording recovery efforts; implementing emergency operations continuity plans; holding disaster trainings and planning meetings with non-profit organizations and faith-based organizations; collaborating with disaster preparedness professionals across public and private sectors; regularly training personnel in disaster preparedness; conducting after-action reviews with organizations; connecting and communicating with community members; coordinating donations for disaster relief; holding preparedness seminars for community members; distributing preparedness materials to vulnerable groups; referring community members to local resources and services; using agency as a shelter and offering resources during and after disaster; hosting a summer disaster preparedness day camp for children

San Francisco, USA (continued)	retrofit funding; developing public mitigation policy; holding public meetings and public workshops to develop retrofit schemes; commissioning research on small businesses preparedness		task force; joining dialysis facility networks; distributing USGS "Putting Down Roots in Earthquake Country" information to hospital patients/staff; holding town hall meetings; collaborating with architects and engineers; engaging in non-structural mitigation	communication; holding monthly coordinated disaster drills across school systems; establishing a phone tree emergency notification system; offering AlertNow text messaging system; issuing faculty preparedness surveys; participating in Neighborhood Emergency Response Team trainings; holding school fundraisers for disaster-stricken communities; distributing emergency information to children and families	
Thimphu, Bhutan	Coordinating all-hazards, all-risk data and information; educating and advising the public regarding earthquake safe construction practices; collaborating with other government agencies; training local builders and artisans to design and build earthquake safe structures; assessing and retrofitting schools; leading "train the trainers" programs for district officers; engaging in media outreach efforts; holding public forums	Engaging in community and media outreach efforts; holding staff training; inventorying houses damaged in disasters	Developing disaster contingency plans; leading "train the trainers" programs; assessing infrastructure risks for hospitals; advocating for retrofitting of hospitals; holding disaster drills and training activities; training doctors in emergency medical services; establishing emergency call centers; developing trauma registries	Holding disaster preparedness workshops with students, teachers, and principals in schools; designing disaster-focused classroom curriculum; encouraging non-structural mitigation in schools; designing earthquake resilient school buildings; involving students and teachers in earthquake preparedness drills and exercises; encouraging student-created plays and skits to help parents learn about earthquake risk	Leading earthquake risk reduction projects and post-2009 earthquake reconstruction projects; holding search and rescue trainings, risk management trainings, etc.; sponsoring safe schools programs; sponsoring cultural conservation of buildings and structural retrofitting programs; developing earthquake simulation exercises; preparing for education in emergencies; working with school principals to develop earthquake hazard mitigation plans

Note: Guwahati, India is not included in the above table, because the interviews in that city were not audio recorded.

Chapter 3 Resource Needs and Preferences

Chapter 2 provided an overview of the programs and initiatives underway in the 11 target cities and described the technical resources and communication channels that respondents currently use in their professional work. The present chapter addresses resource needs across the entire sample and includes city-specific and sector-specific analyses. In addition, this chapter offers a description of the tools, technologies, and trust-building activities that interview respondents said that they would prefer for GEM to focus on, as it develops its platform and tools for earthquake safety practitioners. The chapter concludes with a brief discussion of best practices for communicating risk to practitioners and the public.

This information is key to correcting a dynamic that risk reduction educator Marla Petal has described: "Disaster risk reduction communications have often been *supply driven* (what experts think others should know) rather than *demand driven* (what affected people want and think they need). The assumption on the part of experts tends to be that 'we' already know what 'they' need."[33] This flawed assumption has contributed to the "great gap" between what decision-makers and end users say they want from science and technology, and what science and technology are offering to decision-makers and end users.[34] Fortunately, this gulf between scientific communities and policymaker and practitioner communities is not so great that it cannot be overcome. Engaging in dialogue and needs assessments across the divide is one of the best ways to begin to build bridges between these communities.[35]

3.1. Resource Availability and Resource Needs

The GHI-CSU team collected data on the availability, or lack thereof, of tools and resources from the 119 survey respondents in the 11 target cities. The survey contained 21 closed-ended questions[36] that asked participants to specify whether they "already have," "would like to have," or "do not need" a particular type of information or form of expert guidance to support their professional risk reduction activities within their community. Because the team anticipated that some respondents might have access to particular resources but prefer to have more sophisticated or reliable versions of those resources, the survey included the following statement: "If you already have access to a resource listed on the survey, but would still like the Global Earthquake Model to provide it, please check the 'would like to have' box."

The 21 survey resource items included:

- Projected ground shaking intensity in an earthquake;
- Maps of earthquake fault lines in the community;

[33] Marla Petal. 2007. "Disaster Risk Reduction Education: Material Development, Organization, and Evaluation." *Regional Development Dialogue Journal* 28(2): 1-25.
[34] William Clark and Laura Holliday. 2006. *Linking Knowledge with Action for Sustainable Development: The Role of Program Management.* Washington, DC: National Academies Press.
[35] Ellen B. McCullough and Pamela A. Matson. 2011. "Evolution of the Knowledge System for Agricultural Development in the Yaqui Valley, Sonora, Mexico." Washington, DC: *Proceedings of the National Academy of Sciences.*
[36] See Appendix J for the complete survey questionnaire.

- Maps of potential earthquake-induced landslides or tsunamis in the community;
- Projected number of deaths in an earthquake;
- Projected number of injuries in an earthquake;
- Projected impacts on different population groups (such as elderly, homeless, etc.) in an earthquake;
- Projected damage to housing in an earthquake;
- Projected damage to schools in an earthquake;
- Projected damage to businesses in an earthquake;
- Projected damage to hospitals in an earthquake;
- Projected damage to roads, bridges, and other infrastructure in an earthquake;
- Projected damage to electricity, gas, and water delivery systems in an earthquake;
- Projected damage to mobile phone networks in an earthquake;
- Projected damage to Internet networks in an earthquake;
- Projected economic losses in an earthquake;
- Information about how individuals and families can prepare for earthquakes;
- Information about how organizations can prepare for earthquakes;
- Information about how to fasten contents of buildings so that they will not fall during earthquakes;
- Information about how to strengthen buildings so that they will not collapse during earthquakes;
- Access to technical experts who can identify and explain earthquake risk;
- Access to technical experts who can help individuals or organizations prepare for earthquakes.

Table 3.1 presents the analyses of the 21 resource items, including all 119 survey responses. Although aggregate analyses such as these can mask important differences within the data, they provide the reader with an essential "big picture" perspective on resource availability and resource needs across the entire sample. More nuanced city-specific and sector-specific analyses of resource needs are included in Sections 3.1.1 and 3.1.2 of this chapter.

Table 3.1 summarizes response counts and percentages that describe resource availability and resource needs in the target cities. The table is organized so that the resources least frequently cited as available are at the top of the table, while the resources more frequently available to respondents are at the bottom. As Table 3.1 illustrates, the least frequently available resources included access to projected damage to Internet networks and to mobile phone networks: only 13% and 15% of respondents, respectively, said that they had this information available to them in their professional work. The most commonly available resources included information on how individuals and families can prepare for earthquakes (40% of the sample had this information for their community), projected ground shaking intensity in an earthquake (37% marked this item as available), and maps of earthquake fault lines (36% indicated that they had this information).

The following should be kept in mind when reviewing the data presented in Table 3.1. First, a minority (40% or fewer) of respondents marked that they "already have" any one of the 21 resource items. This indicates that there are many outstanding resource needs within the target communities. Second, the team did *not* ask respondents to rank order the resource items in terms

of their usefulness or desired availability. Instead, respondents identified whether they already have, would like, or do not need each of the 21 items. Thus, the fact that projected damage to Internet networks and mobile networks are listed at the top of the table as resources that the highest numbers of respondents said they "would like" does *not* mean that respondents necessarily view those as the most important resources to have. Rather, this finding indicates only that those resources were least often available in the target cities.

Third, the fact that a respondent did not mark an item as "would like to have" does not mean that the item is unimportant to the person in his or her professional work. The questions that the GHI-CSU team asked of respondents following their completion of the survey revealed that in most cases, when a respondent did not mark a resource as "would like to have," that person already had access to the item. Fourth, and perhaps most importantly, the qualitative interviews also revealed that no single item included on the survey was "most important" to respondents. *Instead, what practitioners said time and again was that they would like to have access to all of the following items, simultaneously, in order to better understand the risk profiles for their respective cities.* This finding has particular relevance for GEM, as it develops its platform and any future tools and resources.

Table 3.1. Resource Availability and Resource Needs

Resource Item	Already Have		Would Like	
	Count (n)	Percentage (%)	Count (n)	Percentage (%)
Projected damage to Internet networks	15	13%	95	82%
Projected damage to mobile phone networks	17	15%	95	83%
Projected impacts on different population groups	21	18%	94	79%
Projected damage to electricity, gas, and water delivery systems	23	20%	92	79%
Projected damage to roads, bridges, and other infrastructure	22	19%	91	80%
Projected number of deaths	24	21%	89	76%
Projected damage to schools	29	25%	88	75%
Projected damage to hospitals	26	22%	88	75%
Maps of potential earthquake-induced landslides or tsunamis	30	26%	87	74%
Projected number of injuries	25	21%	86	74%
Access to technical experts who can identify and explain earthquake risk	33	28%	85	71%
Projected damage to businesses	20	17%	84	72%
Projected economic losses	23	20%	83	73%
Projected damage to housing	32	27%	83	70%
Information about how to fasten contents of buildings	35	29%	80	67%
Access to technical experts who can help individuals or organizations prepare	37	32%	78	67%
Information about how to strengthen buildings	38	33%	77	66%
Information about organizational preparedness	39	34%	76	66%
Maps of earthquake fault lines	43	36%	75	63%
Projected ground shaking intensity	44	37%	74	62%
Information about individual/family preparedness	47	40%	70	59%

Note: Very few respondents marked “do not need” for the 21 survey resource items. For most items, less than 3% of respondents said they did not need a particular information resource. Therefore, the team dropped “do not need” responses from Table 3.1 in an effort to save space and to provide a clearer picture of resource availability and resource needs. The omitted data are available upon request.
Note: Percentages reflect rounded estimates**.**

Carla Johnson *(pictured right) is a disaster planner for the Mayor's Office on Disability in San Francisco, in the United States. She has dedicated her career to helping some of the city's most vulnerable populations to prepare for earthquakes. She has also worked as a building inspector on various publicly funded projects, to ensure that building initiatives are compliant with U.S. laws related to persons with disabilities.*

One of Carla's many contributions to earthquake preparedness has been a map that she created to show the "triple threats" of vulnerable soil conditions, vulnerable buildings, and vulnerable people in the city of San Francisco. By merging data sets, Carla was able to identify the areas in or around the city which should be the most severely affected in the event of a large earthquake, and the location of the individuals most at-risk, including low-income persons with disabilities. The maps were created by overlaying data points for (1) low-income housing properties in San Francisco, obtained through government data; (2) soft-story buildings identified in a San Francisco Department of Building Inspection Survey; (3) the location of 22,000 residents receiving home-based government services, obtained through the U.S. Census; and (4) the liquefaction, tsunami, and landslide zones throughout the city.

"I wanted [the map] to drive some policy decisions on where we would be focusing either our mandatory retrofit programs or certainly at least from the response phase making sure that the fire department and police department know where they're most likely to have to focus all of their resources," Carla said.

Even with the "triple threat" mapped, much work remains to be done in San Francisco. Carla said that the people with the greatest need—low-income individuals living with disabilities—have least capacity to mitigate their risk. "When you go to the single-room occupancy hotels, the disabilities that people have are not just of a physical nature. Many of them … have mental health issues. For some of these people … every day is a disaster. It's hard for them to plan ahead for how they're going to mitigate something as huge as an earthquake. They probably don't even have enough food in their apartment to last them through the week, much less to actually have a stash for three days."

3.1.1. Survey Results: Resource Needs by City

As reported above, *none* of the 21 aforementioned resource items was available to a majority of respondents. In order to understand better the most pressing resource needs and how those needs vary geographically, the team conducted city-specific analyses to compare the resources that respondents "already have" to the resources that they "would like to have." This analysis revealed striking variance across the 11 target cities in terms of reported resource availability and reported needs for earthquake risk reduction activities.

Table 3.2 summarizes and color codes resource response counts and percentages by city and for each item on the survey. Because Table 3.2 is large and includes a large volume of data from the survey, it is important to explain that the table is organized by survey item *and* by city.

To read Table 3.2, begin by looking at the far-left column. This column includes a cell for each of the 21 survey resource items. The resource items are listed in descending order, such that the item at the top of the table (projected damage to Internet networks in an earthquake) represents the most commonly cited resource that respondents would like to have, while the item at the bottom of the table (information about how individuals and families can prepare for earthquakes) represents the least commonly cited resource that respondents would like to have. When read *horizontally*, the numerical data in the table show how many respondents, in each city, ranked an item as "already have" or "would like to have."

To understand how respondents in a particular city categorized each of the 21 survey resource items, read the table *vertically.* The 11 target cities are listed across the third row of the table, such that moving from left to right, respondents reported an increasingly higher number and percentage of resource needs in their city.

In analyzing the data, the team identified clear divisions *across the items* and *among the cities* in terms of resource needs; this allowed for a typology of resource availability and resource needs.[37]

Low Resource Need Item: 40% or fewer of respondents in a city indicated that they would like to have the specific resource captured by the survey item (e.g., projected ground shaking intensity in an earthquake, maps of earthquake fault lines, access to technical experts who can explain earthquake risk) (shown as white cells in Table 3.2).

Moderate Resource Need Item: 41-69% of respondents in a city indicated that they would like to have the specific resource captured by the survey item (shown as yellow cells in Table 3.2).

High Resource Need Item: 70-89% of respondents in a city indicated that they would like to have the specific resource captured by the survey item (shown as orange cells in Table 3.2).

Extreme Resource Need Item: 90-100% of respondents in a city indicated that they would like to have the specific resource captured by the survey item (shown as red cells in Table 3.2).

After analyzing the survey data by item, the team calculated an *overall resource needs percent score* for each city. This score was calculated by adding together the total number of "already have" responses for all 21 items for each city, and comparing that result to the total number of "would like to have" responses. Using this formula and the typology outlined above, the team classified each of the 11 target cities into one of the following four categories based on the percentage of all responses that were "would like to have" (see Figure 3.1). This score represents a relative comparison between cities based on respondents' overall expressed need.

Low Resource Needs Cities: Respondents from **Istanbul** and **San Francisco** expressed the highest levels of resource availability and lowest levels of resource needs. Only 34% of

[37] The classification system—low, moderate, high, extreme—was determined inductively, based on how respondents clustered on particular items. Caution should be exercised in inferring categorical difference among items, cities, or sectors that may only be differentiated by a few percentage points.

respondents from Istanbul and 39% of respondents from San Francisco, across all 21 survey items, reported that they would like to have access to the resources listed on the survey.

Moderate Resource Needs Cities: Respondents from **Antakya** and **Christchurch** reported moderate resource needs, with 60% of respondents from Antakya and 64% from Christchurch,[38] across all 21 survey items, reporting that they would like to have access to the resources listed on the survey.

High Resource Needs Cities: Respondents from **Lima**, **Delhi**, and **Chincha** reported high resource needs, with 71% of respondents from Lima, 88% from Delhi, and 89% from Chincha, across all 21 survey items, indicating that they would like to have access to the resources listed on the survey.

Extreme Resource Needs Cities: Of all the cities, respondents from **Padang**, **Guwahati**, **Thimphu**, and **Bandung** reported the most extreme resource needs and the lowest levels of resource availability, with 91% of respondents from Padang, 92% from Guwahati, 94% from Thimphu, and 99% from Bandung, across all 21 survey items, indicating that they would like to have access to the resources listed on the survey. Bandung stands out, in its particularly acute resource needs: for 19 of the 21 survey items, no respondents from that city marked that they had access to the resource item, while all (11) respondents indicated that they would like to have the item. For the remaining two survey items, only one participant from Bandung said that he or she had that item, while the others indicated that they would like to have it. Similar, if slightly less severe, patterns are evident in survey responses from Guwahati, Thimphu, and Padang.

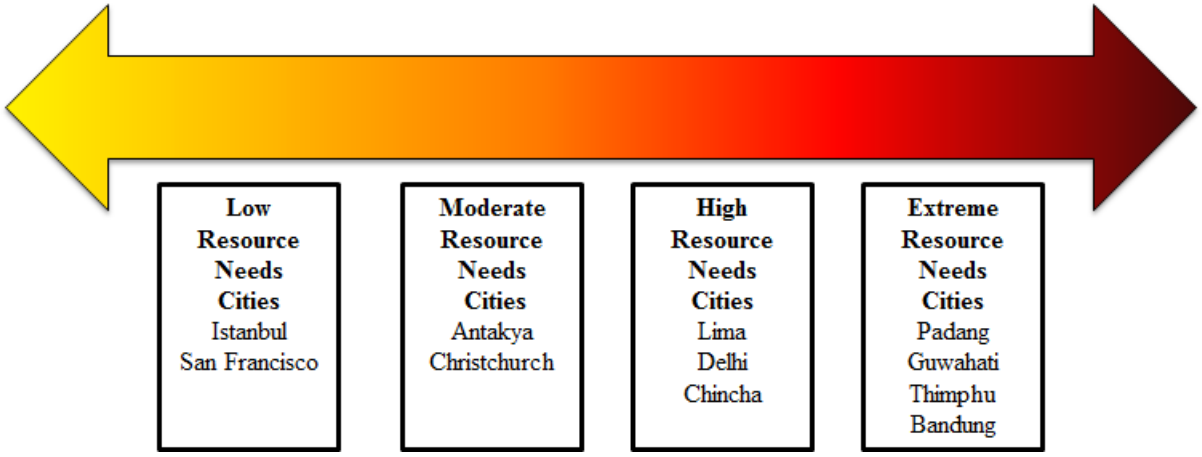


Figure 3.1. Resource Needs by City

[38] Because New Zealand is a high-income country commonly viewed as a world leader in earthquake risk reduction, the resource availability patterns in the responses from Christchurch surprised the GHI-CSU team. After analyzing the interview data, the team identified two factors that help to explain why Christchurch was ranked lower than anticipated. First, because Christchurch had been recently struck by consecutive earthquake disasters, its respondents were particularly alert to gaps in their resources and information sources. Second, because Christchurch had not previously been perceived as being in a high seismic hazard zone in New Zealand, earthquake mitigation had concentrated on other cities like Auckland and Wellington; as a result, Christchurch was less prepared.

Before proceeding to review the data presented in Table 3.2, it is important to reiterate that the fact that a respondent did not mark an item as “would like to have” does not mean that the item is unimportant to the respondent in his or her professional work. The questions that the GHI-CSU team asked respondents following their completion of the survey revealed that in most cases, when a respondent did not mark a resource as “would like to have,” that person already had access to the item.

Table 3.2. Survey Resource Needs: Response Counts and Percentages by City

	City																			
	Low Needs Cities				*Moderate Needs Cities*				*High Needs Cities*						*Extreme Needs Cities*					
	Istanbul		**San Francisco**		**Antakya**		**Christchurch**		**Lima**		**Delhi**		**Chincha**		**Padang**		**Guwahati**		**Thimphu**		**Bandung**	
Resource Item	Have	Would like	Have	Would like	Have	Would like	Have	Would like	Have	Would like	Have	Would like	Have	Would like	Have	Would like	Have	Would like	Have	Would like	Have	Would like
Internet Damage	3 30%	7 70%	2 22%	7 78%	2 25%	6 75%	5 31%	11 69%	1 7%	12 93%	1 9%	10 91%	1 13%	7 87%	0 0%	10 100%	0 0%	5 100%	0 0%	9 100%	0 0%	11 100%
Mobile Damage	4 40%	6 60%	2 20%	8 80%	2 22%	7 78%	5 31%	11 69%	2 18%	9 82%	1 9%	10 91%	1 10%	9 90%	0 0%	10 100%	0 0%	6 100%	0 0%	8 100%	0 0%	11 100%
Business Damage	6 67%	3 33%	5 50%	5 50%	2 25%	6 75%	4 25%	12 75%	2 18%	9 82%	0 0%	10 100%	1 13%	7 87%	0 0%	9 100%	0 0%	4 100%	0 0%	8 100%	0 0%	11 100%
Differential Impacts	5 56%	4 44%	4 36%	7 64%	3 38%	5 62%	5 31%	11 69%	3 21%	11 79%	0 0%	11 100%	1 10%	9 90%	0 0%	9 100%	0 0%	7 100%	0 0%	9 100%	0 0%	11 100%
Road Damage	6 60%	4 40%	5 50%	5 50%	2 22%	7 78%	6 38%	10 62%	2 17%	10 83%	0 0%	11 100%	1 13%	7 87%	0 0%	10 100%	0 0%	8 100%	0 0%	8 100%	0 0%	11 100%
Utility Damage	6 60%	4 40%	4 44%	5 55%	3 38%	5 62%	6 38%	10 62%	3 21%	11 79%	0 0%	11 100%	1 10%	9 90%	0 0%	9 100%	0 0%	8 100%	0 0%	9 100%	0 0%	11 100%
Economic Losses	8 80%	2 20%	6 60%	4 40%	2 25%	6 75%	3 25%	9 75%	4 33%	8 67%	0 0%	11 100%	0 0%	9 100%	0 0%	9 100%	0 0%	6 100%	0 0%	8 100%	0 0%	11 100%
Projected Deaths	7 78%	2 22%	6 55%	5 45%	3 33%	6 67%	2 15%	11 85%	5 36%	9 64%	0 0%	11 100%	1 10%	9 90%	0 0%	9 100%	0 0%	7 100%	0 0%	9 100%	0 0%	11 100%
Projected Injuries	7 78%	2 22%	6 55%	5 45%	3 33%	6 67%	2 15%	11 85%	5 36%	9 64%	0 0%	11 100%	1 10%	9 90%	0 0%	9 100%	0 0%	7 100%	0 0%	9 100%	0 0%	11 100%
Hospital Damage	6 67%	3 33%	6 55%	5 45%	3 38%	5 62%	5 31%	11 69%	3 21%	11 79%	0 0%	11 100%	2 22%	7 78%	0 0%	9 100%	0 0%	7 100%	1 11%	8 89%	0 0%	11 100%
School Damage	7 70%	3 30%	4 40%	6 60%	3 33%	6 67%	5 31%	11 69%	6 43%	8 57%	1 10%	9 90%	2 20%	8 80%	0 0%	9 100%	0 0%	8 100%	1 11%	8 89%	0 0%	11 100%
Landslide or Tsunami Maps	5 56%	4 44%	9 82%	2 18%	2 25%	6 75%	7 44%	9 56%	5 39%	8 61%	0 0%	11 100%	0 0%	10 100%	2 20%	8 80%	0 0%	7 100%	0 0%	8 100%	0 0%	11 100%
Housing Damage	6 60%	4 40%	7 70%	3 30%	4 44%	5 56%	4 25%	12 75%	4 31%	9 69%	1 9%	10 91%	4 40%	6 60%	0 0%	8 100%	0 0%	8 100%	2 22%	7 79%	0 0%	11 100%
Risk Experts	6 60%	4 40%	7 70%	3 30%	4 44%	5 56%	7 44%	9 56%	3 21%	11 79%	2 18%	9 82%	0 0%	10 100%	0 0%	10 100%	3 38%	5 62%	0 0%	9 100%	1 9%	10 91%
Building Contents	4 50%	4 50%	8 80%	2 20%	5 56%	4 44%	9 56%	7 44%	1 7%	13 93%	1 9%	10 91%	0 0%	9 100%	4 40%	6 60%	2 25%	6 75%	1 11%	8 89%	0 0%	11 100%
Preparedness Experts	6 60%	4 40%	7 70%	3 30%	5 56%	4 44%	8 50%	8 50%	4 36%	7 64%	2 18%	9 82%	0 0%	10 100%	0 0%	10 100%	3 38%	5 62%	1 11%	8 89%	1 9%	10 91%
Strengthen Building	7 78%	2 22%	10 91%	1 9%	4 44%	5 56%	7 44%	9 56%	2 18%	9 82%	3 27%	8 73%	0 0%	10 100%	2 20%	8 80%	1 13%	7 87%	2 22%	7 78%	0 0%	11 100%
Organization Preparedness	9 90%	1 10%	6 67%	3 33%	3 33%	6 67%	7 44%	9 56%	6 50%	6 50%	2 18%	9 82%	1 10%	9 90%	3 30%	7 70%	1 13%	7 87%	1 11%	8 89%	0 0%	11 100%
Maps of Fault Lines	8 80%	2 20%	10 91%	1 9%	8 89%	1 11%	6 38%	10 62%	5 36%	9 64%	3 27%	8 73%	0 0%	10 100%	3 30%	7 70%	0 0%	7 100%	0 0%	9 100%	0 0%	11 100%
Ground Shaking	7 78%	2 22%	9 82%	2 18%	5 56%	4 44%	6 38%	10 62%	6 43%	8 57%	6 55%	5 45%	3 30%	7 70%	0 0%	10 100%	1 13%	7 87%	1 11%	8 89%	0 0%	11 100%
Family Preparedness	8 89%	1 11%	8 80%	2 20%	5 56%	4 44%	8 50%	8 50%	7 50%	7 50%	3 27%	8 73%	2 20%	8 80%	4 40%	6 60%	1 13%	7 87%	1 11%	8 89%	0 0%	11 100%
Total	131 66%	68 34%	131 61%	84 39%	73 40%	109 60%	117 36%	209 64%	79 29%	194 71%	26 11%	203 89%	22 11%	179 89%	18 9%	182 91%	12 8%	139 92%	11 6%	173 94%	2 1%	229 99%

White: Low resource need, where 40% or fewer of respondents indicated that they would like to have access to stated item.

Yellow: Moderate resource need, where 41-69% of respondents indicated that they would like to have access to stated item.

Orange: High resource need, where 70-89% of respondents indicated that they would like to have access to stated item.

Red: Extreme resource need, where 90-100% of respondents indicated that they would like to have access to stated item.

Note: Although 119 individuals completed the survey, the counts do not always total 119, because (1) some individuals did not answer all of the survey items, and (2) the "do not need" responses were removed from Table 3.2.
Note: Percentages reflect rounded estimates and may not sum to 100 percent.

Ali Hoca *(pictured right) is a civil engineer and owner of a construction company in Antakya, Turkey. His company strengthens and retrofits local government and private sector buildings.*

In Antakya, the municipality and Chamber of Civil Engineers is responsible for identifying weak buildings and then hiring construction companies to update them according to regulations. Once a structure is identified, all of the people who reside in the building must come to a consensus about the upgrades before construction can begin. In this arrangement, the municipality offers to pay for up to 70% of the upgrades, with the building owner covering the remaining 30% of the cost. Even with this generous support, it is difficult to get people to upgrade their homes and businesses.

During a recent project, Ali learned that it is not always the financial burden that dissuades people from making their homes and buildings safer. In fact, some building owners said "no" to the retrofit because they are concerned that the construction will disrupt their daily lives. This was until Ali explained, "We don't enter your house so much, just four or five times we enter your house, so you don't have to go anywhere. You can live there when we work in these buildings." After Ali would explain this, the building owners, according to him, were more likely to say, "Okay, we accept it."

Ali is committed to raising earthquake awareness in his community. He wrote a report about existing structures and distributed a survey, but he explains that people do not want to hear about earthquakes and are very forgetful.

With a limited budget, Ali can afford to attend very few international conferences. He told the project team that it would be "great" to have access to Turkish-language examples of international best practices so that he could use the information to improve his work.

3.1.2. Survey Results: Resource Needs by Sector

The GHI-CSU team also analyzed the survey resource data by sector. Table 3.3 summarizes and color codes resource availability response counts and percentages by sector and for each item on the survey. Because Table 3.3 is large and includes a large volume of data from the survey, it is important to explain that the table is organized by survey item *and* by sector, similar to the city table presented above.

As with Table 3.2, to read Table 3.3, begin by looking at the far-left column. This column includes a cell for each of the 21 survey resource items. These items are listed in descending order, such that the resource item at the top of the table (projected damage to Internet networks in an earthquake) represents the most commonly cited resource that respondents would like to have, and the resource item at the bottom of the table (information about how individuals and families can prepare for earthquakes) represents the least commonly cited resource that

respondents would like to have. When read *horizontally*, the numerical data in the table show how many respondents, in each city, ranked an item as "already have" or "would like to have."

To understand how respondents from a particular sector responded to each of the 21 survey items, read the table *vertically.* The five key sectors are listed across the third row of the table, such that moving from left to right, respondents reported an increasingly higher number and percentage of resource needs in their professional sector.

In analyzing the data, the team identified divisions *across the items* and *among the sectors* in terms of expressed resource needs; this allowed for a typology of resource availability and resource needs.[39]

Low Resource Need Item: 40% or fewer of respondents in a sector indicated that they would like to have the specific resource captured by the survey item (shown as white cells in Table 3.3).

Moderate Resource Need Item: 41-69% of respondents in a sector indicated that they would like to have the specific resource captured by the survey item (shown as yellow cells in Table 3.3).

High Resource Need Item: 70-89% of respondents in a sector indicated that they would like to have the specific resource captured by the survey item (shown as orange cells in Table 3.3).

Extreme Resource Need Item: 90-100% of respondents in a sector indicated that they would like to have the specific resource captured by the survey item (shown as red cells in Table 3.3).

After analyzing the survey data by item, the team calculated an *overall resource needs percent score* for each sector by adding together the total number of "already have" responses per sector and adding the total number of "would like to have" responses within each sector. Together these totals represent all of the responses in the table for that sector, and the percentage of all sector-specific responses that were either "already have" or "would like to have" was calculated and compared. This percentage comparison indicates which sectors had more responses *overall* falling into the "would like to have" resource category.

The following findings are apparent in Table 3.3:

First, most of the survey resource item responses, when analyzed by sector, fall into the middle categories of "moderate" or "high" resource needs, with fewer responses at either end of the resource needs spectrum.

Second, and related to the prior point, when compared to the city-specific analyses, far fewer items in the sector-specific analyses warranted being considered an "extreme resource need." The only items that met that threshold were projected damage to Internet networks in an earthquake (96% of government respondents said they would like this information); projected damage to mobile phone networks, projected damage to businesses, projected impacts on

[39] The classification system—low, moderate, high, extreme—was determined inductively, based on how respondents clustered on particular items. Caution should be exercised in inferring categorical difference among items, cities, or sectors that may only be differentiated by a few percentage points.

different population groups, and projected damage to hospitals (95% of business respondents would like access to these four items); and projected damage to infrastructure, projected damage to utility systems, and projected damage to housing (90% of business respondents would like access to these three items).

Third, of the sectors, respondents representing business reported the lowest overall levels of resource availability (19%) and highest overall levels of resource needs (81%).

Fourth, no sector reported a total percentage of resource needs that was either sufficiently low or sufficiently extreme to meet the criteria of *Low*, *Moderate*, or *Extreme Resource Needs* categories created in the analyses. All five sectors met the criteria to be considered *High Resource Needs Sectors*, with respondents representing **education**, **health care**, **government**, **grassroots**, and **business** reporting totals that indicated that they had access to 30% or fewer of the resources assessed in the survey and that they would like to have access to 70-89% of the items that the survey included (see Figure 3.2 and Table 3.3).

The fact that all five sectors were classified as *High* on the resource needs scale indicates that there is little variability *across* the sectors in the individual responses. However, there was substantial variability *within* the same sector. Compared to the city-specific analyses presented previously, this result implies that *geographic location* likely has a greater impact upon respondents' reported resource needs than does *sector.*

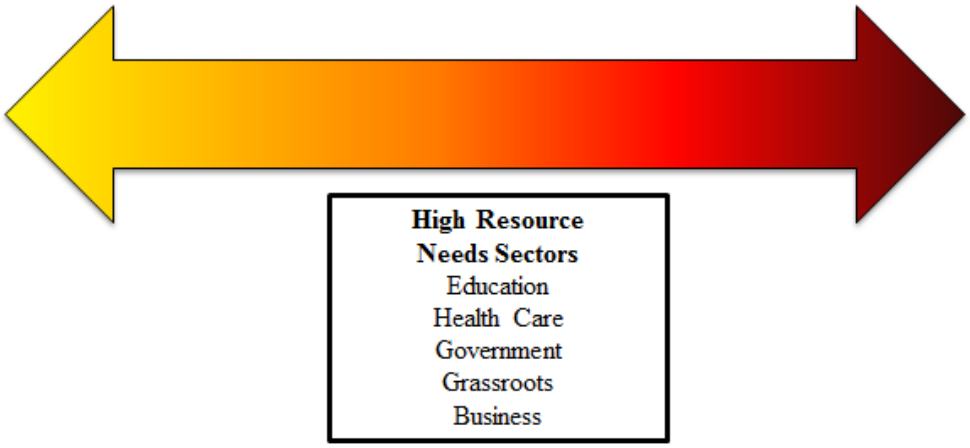


Figure 3.2. Resource Needs by Sector

Again, please note that the fact that a respondent did not mark an item as "would like to have" does not mean it was not important to the respondent in his or her professional work. The questions that the GHI-CSU team asked respondents following completion of the survey revealed that in most cases, when a respondent did not mark a resource as "would like to have," that person already had access to the item.

Table 3.3. Survey Resource Needs: Response Counts and Percentages by Sector

	Sector									
	High Needs Sectors									
	Education		**Health Care**		**Government**		**Grassroots**		**Business**	
Resource Item	Have	Would like	Have	Would like	Have	Would like	Have	Would like	Have	Would like
Internet Damage	4 19%	17 81%	4 19%	17 81%	1 4%	26 96%	4 18%	18 82%	2 11%	17 89%
Mobile Damage	3 13%	21 87%	5 25%	15 75%	3 11%	24 89%	5 24%	16 76%	1 5%	19 95%
Differential Impacts	7 29%	17 71%	3 14%	18 86%	6 21%	23 79%	4 18%	18 82%	1 5%	18 95%
Utility Damage	7 28%	18 72%	3 15%	17 85%	7 25%	21 75%	4 18%	18 82%	2 10%	18 90%
Road Damage	5 22%	18 78%	4 19%	17 81%	7 25%	21 75%	4 19%	17 81%	2 10%	18 90%
School Damage	10 40%	15 60%	6 30%	14 70%	6 21%	22 79%	6 21%	22 79%	6 26%	17 74%
Projected Deaths	6 24%	19 76%	5 25%	15 75%	5 18%	23 82%	5 24%	16 76%	3 16%	16 84%
Hospital Damage	5 24%	16 76%	8 36%	14 64%	8 28%	21 72%	4 18%	18 82%	1 5%	19 95%
Projected Injuries	7 29%	17 71%	6 27%	16 73%	5 17%	24 83%	4 21%	15 79%	3 18%	14 82%
Risk Experts	7 28%	18 72%	7 32%	15 68%	9 31%	20 69%	5 23%	17 77%	5 25%	15 75%
Business Damage	4 22%	14 78%	4 24%	13 76%	7 24%	22 76%	4 20%	16 80%	1 5%	19 95%
Economic Losses	7 33%	14 67%	3 16%	16 84%	5 18%	23 82%	5 26%	14 74%	3 16%	16 84%
Housing Damage	8 35%	15 65%	10 48%	11 52%	8 28%	21 72%	4 18%	18 82%	2 10%	18 90%
Building Contents	8 32%	17 68%	8 40%	12 60%	10 35%	19 65%	4 18%	18 82%	5 26%	14 74%
Preparedness Experts	6 25%	18 75%	8 36%	14 64%	10 35%	19 65%	6 30%	14 70%	7 35%	13 65%
Strengthen Building	8 32%	17 68%	7 35%	13 65%	11 38%	18 62%	7 33%	14 67%	5 25%	15 75%
Organizational Preparedness	10 40%	15 60%	8 38%	13 62%	12 43%	16 57%	5 24%	16 76%	4 20%	16 80%
Maps of Fault Lines	10 42%	14 58%	7 32%	15 68%	13 45%	16 55%	7 30%	16 70%	6 30%	14 70%
Landslide or Tsunami Maps	8 38%	13 62%	6 33%	12 67%	7 28%	18 72%	4 19%	17 81%	5 26%	14 74%
Ground Shaking	9 36%	16 64%	7 32%	15 68%	13 45%	16 55%	7 30%	16 70%	8 42%	11 58%
Family Preparedness	10 40%	15 60%	9 41%	13 59%	15 52%	14 48%	8 36%	14 64%	5 26%	14 74%
Total	149 30%	344 70%	128 30%	305 70%	168 28%	427 72%	106 23%	348 77%	77 19%	335 81%

White: Low resource need, where 40% or fewer of respondents indicated that they would like to have access to stated item.	Yellow: Moderate resource need, where 41-69% of respondents indicated that they would like to have access to stated item.	Orange: High resource need, where 70-89% of respondents indicated that they would like to have access to stated item.	Red: Extreme resource need, where 90-100% of respondents indicated that they would like to have access to stated item.

Note: Although 119 individuals completed the survey, the counts do not always total 119, because: (1) some individuals did not answer all of the survey items, and (2) the "do not need" items were removed from Table 3.3.
Note: Percentages reflect rounded estimates and may not sum to 100 percent.

Pedro Ferradas Mannucci *is the program manager of risk management and adaptation to climate change in the Lima, Peru, office of the nonprofit Practical Action. He works on many community-centered risk reduction projects and is currently helping to develop a city-wide risk reduction strategy for the municipality of Lima. In drafting the plan, he is relying on recent research that includes estimates of the probable impact of future earthquakes and tsunamis on Lima, including specific data about the vulnerability of homes throughout the city.*

Practical Action, which partners with major international organizations like the World Bank and Save the Children, engages community members through a participatory approach to risk evaluation. "We don't come in with an agenda already developed. Generally, [our approach is] based on some participatory risk evaluation. We don't propose that engineers and architects come and do the work alone, but instead they have to do it with the leaders of the communities," Pedro says. Local knowledge is central to disaster mitigation in at-risk areas. Seismologists and engineers often miss important information by neglecting to incorporate local knowledge into their calculations.

Pedro says that what he needs most is a communication strategy that is oriented toward earthquake risk reduction. "One of the central problems in all of this, some of this is attributable to poverty, but I think it is part of a culture of today and yesterday. People think more about what happened yesterday than what could occur tomorrow… I think there's much work to be done to change the schema [in order to help people recognize] that the future could be better in terms of safety."

3.1.3. Resource Needs: Local Partners and "GEM Fellows"

The GHI-CSU team interviewed all of the local partners on this project to discuss how they (and other persons in similar professional positions) could potentially be recruited and trained to use GEM's tools to promote risk management activities in their communities.[40] At the March 2012 Pavia workshop, participants agreed that GEM should create a "GEM Fellows" program that would recognize and support the efforts of earthquake safety practitioners in communities worldwide. Comments from the local partners during these interviews provided some ideas that GEM could consider, if the Foundation decides to create such a program.

All of the local partners expressed an interest in working with GEM, and many said that training would be equally important to financial support in attracting candidates for the "GEM Fellows" program. The local partners recommended that the GEM Foundation provide training in the use of its tools and resources, and provide opportunities for selected practitioners to attend training workshops; offer remuneration for the work done; make available mentors who could advise on risk reduction best practices; provide support to participants for several years, not just short-term awards; and clearly articulate what the participants are expected to achieve as a result of this support.

[40] See Appendix G and Appendix H for biographical sketches and contact information for the local partners who assisted with the project.

3.1.4. Resource Needs: International Organizations

During field visits, the GHI-CSU team met with five local officials from international development organizations, including the World Bank, the United Nations Development Programme (UNDP), and the United Nations Children's Fund (UNICEF).[41] The officials all expressed an interest in using GEM's tools and resources to promote or implement risk reduction activities. The recurring theme in these interviews was that providing local leaders with risk information was not sufficient to reduce risk; leaders also need help in deciding what to do with risk information to initiate change in their communities.

3.2. Resource Preferences

During interviews, the GHI-CSU team posed a series of questions designed to explore in greater depth what resources the respondents need to facilitate their risk reduction work; how they prefer to receive and use risk reduction resources; and what factors influence their decision-making when adopting new resources. Some of the questions asked the interviewees to respond directly with advice for GEM, as it moves forward with creating products for earthquake risk reduction practitioners; in other instances, the qualitative data outlined below emerged in the course of the normal interview exchange. The analyses of the interview responses, which are elaborated on in the following sub-sections, are organized by the thematic areas of: (1) tools and technologies; (2) requests and recommendations; and (3) trust and partnerships.

3.2.1. Tools and Technologies

When the project team asked interviewees what they need to facilitate their professional work, most responded by first identifying "unanswered questions" which they hoped that a new tool, technology, or resource might address. Table 3.4 summarizes general areas of concern identified by respondents, along with related information or resource needs.

[41] See Appendix F for a listing of the names and contact information for these respondents.

Table 3.4. Areas of Concern and Resource Needs (continues on next page)

Area of Concern	Questions a New Tool, Technology, or Resource Might Address
General earthquake risk information	• How can we most effectively communicate complex risk to the public(s) we serve? • How can the public be convinced that they need to take action to protect themselves and their property before an earthquake? • Where are the earthquake fault lines that may affect our city? Can so-called "blind faults" be discovered and mapped? • What is the likely magnitude of an earthquake in this city? • How many lives may be lost? • How does risk of death or injury vary by (1) location (e.g., if you are inside or outside during an earthquake) and (2) time of day (e.g., if the event occurs at night or during the day)? • How much destruction in terms of building damage and building collapse may occur? How will that destruction vary by magnitude of the event?
Multi-hazards risk information	• What are the potential consequences of additional threats or hazards—like fire, tsunami, and floods—that might follow an earthquake? • What other hazards, besides earthquakes, does my city face? • Can other hazards besides earthquakes be integrated into GEM's new technologies? • Instead of a 'global earthquake model,' could we have a technology that is a 'global hazards model'?
Building stock and vulnerability	• How many buildings are in the city? • How old are the buildings? • What building materials were used to construct the structure? • Which buildings are collapse hazards? • Which buildings may catch fire, if a fire follows an earthquake? • How long will it take to repair buildings after an earthquake? • How do you decide which buildings should be demolished, when they are damaged in an event?
Structural mitigation efforts	• How can you strengthen a building? • How do you decide which buildings should be reinforced? • Are there any buildings that should be taken down completely, because they cannot be reinforced in advance of an earthquake?
Non-structural mitigation efforts	• How do I fasten building contents appropriately? • Besides fastening contents in a building, what other non-structural mitigation efforts should my organization make?

Table 3.4. Areas of Concern and Resource Needs (continued)

Area of Concern	Questions a New Tool, Technology, or Resource Might Address
Infrastructure systems, emergency evacuation, and vulnerability	• If infrastructure—like roads and bridges—are damaged or destroyed, could we have a simulation that would help us plan alternate transportation routes? • What is the best way to manage traffic flows out of affected areas in an earthquake or tsunami? • How can we develop proper signage for emergency evacuation routes?
Interconnection between different sectors of society	• How much damage will schools, hospitals, businesses, government offices, and non-profit agency offices experience in an earthquake? • Which, if any, sector of society is most important to "protect," to ensure the highest levels of community resilience (e.g., should schools be prioritized over businesses)? Said differently, where should communities start with their mitigation activities, especially if they have limited resources? • Can collaborative planning, preparedness, and mitigation efforts be encouraged?
Social and psychological vulnerability	• How can we help children cope after an earthquake? • What is the best way to overcome trauma? • What are the best practices for communicating risk to different vulnerable segments of society—like the elderly, children, and the homeless?
Emergency response planning and simulation exercises	• What resources—such as medicine, food, water, equipment, etc.—would be required for the population in the event of an earthquake? • If large numbers of people perish in an earthquake, how will the bodies be disposed of?
Best practices	• Could we learn from what other communities are doing? • What decisions are other cities making, as they mitigate their earthquake risk? • Is there a clearinghouse of best practices for earthquake risk reduction?

Respondents indicated that if GEM could develop new tools or technologies to address their concerns and answer their questions, then they would like to have that information delivered through a variety of forms and channels, including:

- Maps and other visuals;
- Charts, tables, and other graphics that summarize relevant data or statistical information;
- One- to two-page handouts summarizing earthquake risk information for the city/region;
- Visually appealing posters that communicate earthquake risk information and that could be presented at conferences, displayed in office buildings and schools, and used in other public meeting spaces;
- Short narratives highlighting mitigation and preparedness success stories;
- PowerPoint™ slides that could be posted online and shared with decision-makers and members of the public;
- In-person or web-based presentations by GEM experts;

- Online simulations or games for children and adults;
- Customizable computer programs that include geographic information systems (GIS) and other mapping functionalities;
- Short briefings that could be shared with journalists and other representatives from the news media;
- Web-accessible videos, especially those demonstrating how to prepare for an earthquake and how to take specific structural or non-structural mitigation actions;
- Web pages designed with the general public in mind, which could be linked to websites from different sectors.

There was a consensus among respondents that they preferred to receive resources electronically (through email messages or via websites). A number of respondents noted, however, that having hard copies of resources, "something you can put your hands on and look at," was also important when attempting to understand new or complex risk information.

3.2.2. Requests and Recommendations

The respondents in this study, even those in the cities with fewest resources available, had strong opinions about what they need and want in terms of features and functionalities in risk reduction resources. Because most of the participants were seasoned earthquake safety practitioners, they had learned over the years what works—and what does not—when it comes to understanding and communicating earthquake risk both to their colleagues and to the public.

First, the interviewees emphasized numerous times how important it was to them that any new products or tools that they adopt be *user-friendly.* Many of the participants told humorous stories about times they had been overwhelmed by overly-technical resources, stilted language that they could not understand, and poorly-designed websites that "crammed too much information onto the pages." The following respondent described her feeling of overwhelm, after reviewing some technical resources:

> I look for information that speaks to me so it's not so technical, but also not so simple [as to not be useful]. [Any product] just must be accessible for me, so that I can understand it. Then I can take it and make it even more user-friendly for the population. So I look for simplicity and accessibility, because some information is very technical to the point of making me dizzy. [laughter]
>
> ~Grassroots Respondent, Chincha

The respondents also indicated that these user-friendly resources were important, because they had limited time available to dedicate to reviewing new materials. Thus, they needed information that they could "scan" and "access" easily.

> Regrettably, we do not have much time. So we need maps, information we can scan quickly that we can access and use to assess risk. If they send a book this thick [holds up hands], no, it has to be in the context of information that can be managed and extracted quickly. Time is important. Yes sometimes when I get a report that I have to respond to, I

> have to read it all. But if I'm doing a report for a region and what that region needs, I just need a map of risk and threat areas, but I don't have this information so I don't know it.
>
> ~Health Care Respondent, Lima

Earthquake safety practitioners and others who work in the area of hazards planning often face an uphill battle in convincing decision-makers and the public about the urgency of preparing for an impending disaster. Thus, respondents noted that if GEM could help them to develop "short, locally relevant, public service announcements that sensitize the public to earthquake risk," then that would help their professional efforts tremendously.

Second, in their quest for user-friendly, easily accessible materials, respondents emphasized how important it was for them to obtain information with *clearly defined and consistent terminology.* Because so much of the information that practitioners use in their daily work is highly technical—generated by scientists and engineers—they often have to struggle to understand the terminology and key messages. Sometimes, this is also a problem of "translation" across languages, cultures, and/or contexts, as this respondent from New Zealand observed:

> One thing that came into my mind when you were talking about—in America, you've got terms, and in New Zealand there might be a slightly different term. When you say "stock" or even the word "bracing," some people may not understand truly what bracing is about. So it is important to emphasize terminology, what things mean, don't assume everybody understands it.
>
> ~Grassroots Respondent, Christchurch

The respondent from Chincha quoted earlier indicated that she needed accessible information, so that she could "take it and make it even more user-friendly for the population." Practitioners serve as the "bridge" between scientific communities and the public; for that reason, respondents viewed using clear and consistent terminology that could be understandable to professionals and the public as essential.

Third, it was important to interviewees that any new technology they use be *customizable, site-specific,* and *sector-specific.* The professionals viewed much of the information and technology that they currently had available as problematic and only partially helpful, because it was not developed with their particular geographic, hazards, and social contexts in mind.

> We already have earthquake maps and some of that information, but I think it has to be customized to the context of Delhi. Most of the things that we have are not customized to the place, for the people who actually live here, so it is not that useful to us.
>
> ~Government Respondent, Delhi

Indeed, there was a general sense among many respondents that the tools they had were not particularized enough to their communities, and hence not useful.

> To me, some of those models generalize things too much, particularly for places like Christchurch where the variation in ground-shaking intensity and liquefaction is so great because of the soils. It's highly variable because of the nature of the soils here. So any

> generalized mapping or any model that generalized those conditions would not be of a great value because things are so site-specific here.
>
> ~Government Respondent, Christchurch

> Here in Chincha, we have a different soil than that in Lima. But all of the resources we have were designed by or for those in Lima. That does not help us here.
>
> ~Government Respondent, Chincha

> I think some of the tools like software and other things could be very, very useful, but the tools will have to be customized. Again, we can't have tools which are designed but not customized. I think a lot of customization is required. If you want to really sensitize one section of society to risk, then you have to reach businesses, the schools, the government. Also, in the city of Delhi, people will not relate to earthquakes happening in Gujarat. That's the sad part. It's a huge communication challenge. If you tell them, "Look what is happening in Gujarat, so many people died," they say, "Earthquakes happen in Gujarat. They will not happen in Delhi." For that reason, computer simulators would have to be customized accordingly.
>
> ~Business Respondent, Delhi

Most of the practitioners interviewed for this study collaborated with professionals in sectors other than their own, such as someone in government working with someone in education. It was frustrating to the respondents that they were not able to access resources that enabled them to understand and assess risk both within their own sector *and* across critical societal sectors. An interviewee from Bandung commented on this issue:

> We are very concerned about how to get information for the hospitals and the other schools and businesses in the area, how to coordinate, and how to mobilize the resources very fast, as soon as possible to come to the area. We are responsible for health, but we also need to know about and understand what is happening in the other areas of our community. That is very important. That is our concern, because many people want to understand, want to coordinate across the whole community. But where will we get this information?
>
> ~Health Care Respondent, Bandung

Even those respondents who had access to reliable data that allowed them to understand their earthquake risk with a high degree of confidence wanted more specific information. For example, this respondent from San Francisco who worked for the utility sector explained how much more effective he would be at his job, if he could access more precise data:

> They [Hazus™ models and U.S. Geological Survey data] are good for regional—big regions, and estimating, like, building collapses in San Francisco. I don't know how good they are in predicting… I don't know to what extent they've identified, "We have this number of soft-story buildings in San Francisco, we have this number of non-ductile concrete buildings, they have a certain capacity and if we have this shaking it'll fail." I don't know if the model is that precise. I think it's broader than that. So to the extent we can have—if we could see a map of San Francisco and not necessarily just our

> infrastructure, but if we could see pockets of the vulnerable buildings, identify the soft-story buildings in this neighborhood, just a graph that would show that, it could be red, yellow, green, red being high potential for collapse, green being in good shape.
>
> Interviewer: Would that help you because it would allow you to better prioritize your work?
>
> I think it would be most helpful because we have no authority or responsibility to upgrade, but it would be most helpful in preparing for an emergency response.
>
> ~Business Respondent, San Francisco

A fourth theme that emerged in the interview data was the need to have access to the most *current, up-to-date information* possible, so that respondents could better grasp and explain their levels of earthquake risk. Some of the respondents in cities that the team studied had information that was difficult to find and decades old.

> We have a pretty good inventory of our infrastructure, but a lot of it is buried, and a lot of it was assembled decades ago. That is something that if there was some magic tool to be able to help us there, that would really be great.
>
> ~Business Respondent, San Francisco

Even those respondents who had data that were only a few years old highlighted how quickly that information could go out of date, as new buildings are built, new lifelines are established, and/or population demographics rapidly change.

> I need better projections of number of injuries in an earthquake, number of deaths. We have this information, but it is based on [the earthquake that] occurred in 2007 [in Peru]. This population here has grown significantly since the earthquake—as if the earthquake attracted more people to the city. So now we no longer have an exact projection. I would like to have that updated on a regular basis.
>
> ~Grassroots Respondent, Chincha

Fifth, respondents indicated that it would be exceptionally helpful to them if GEM were to develop a technology that would help them to *integrate disparate information sources.* Understanding earthquake risk was often an uneven and uncertain process, in which respondents would collect information from one source (e.g., a government website), be provided with information by another source (e.g., a non-governmental organization or a private-sector risk management firm), pick up information at another venue (e.g., a professional conference), etc. As a consequence of this piecemeal process of gathering risk reduction materials, respondents had guidebooks, reports, and pamphlets scattered about their offices, various maps hanging on their walls, and informational emails and data on their computers; what they did not have was one centralized and centrally-accessible database or program that would aggregate this information in a user-friendly and helpful way. A respondent from San Francisco emphasized how much this would help him in his public health and disaster preparedness work:

> What I'm saying is, I haven't seen that level of detail personally, that type of resource where it is a one-stop-shop. I don't know if it can even be obtained or extrapolated. We do get certain things, like when we have a particular [disaster] scenario… Okay, if the epicenter is here and this is the level of ground shaking and the duration, we can then do the maps of all of the other stuff and get some numbers and a lot more detail. It's just, it's very scenario-specific. But we have—the resources are there, they just aren't in one place. I don't always have them at my fingertips. I usually have a piece here, a partial bit there, and then we have to do some digging to find the rest.
>
> ~Health Care Respondent, San Francisco

A sixth request that practitioners in cities in both developed and developing countries expressed was to have more *consistent access to technical experts,* who could help to explain their earthquake risk and ultimately, help to convince decision-makers of the importance of funding and supporting mitigation activities. This was also one of the primary resources that participants said that they would want, when responding to the survey (see Table 3.2 and Table 3.3 above).

> What occurs is that the information that we already have is minimal and incomplete. So for us, it would be important to have maps of fault lines, know the risk zones, and have consultants or technical professionals who are specialized in these topics.
>
> ~Government Respondent, Chincha

> What would be helpful to me is talking to somebody with scientific expertise. I unfortunately don't get the chance to do it, but I think it would be quite valuable.
>
> ~Government Respondent, San Francisco

3.2.3. Trust and Partnerships

Another subject that the respondents discussed at length was what makes them trust—and ultimately adopt—new tools and technologies. A fundamental trust in the credibility of information (re)sources emerged as a particularly salient theme in the qualitative data; as one respondent emphasized, "If I do not know where the information came from and do not know or trust the person who shared it, I will not use it."

So where does that trust originate, and how can GEM establish credibility with practitioners? Several interviewees noted that the "science" behind the tool or resource was most important to them. A business respondent from Antakya made this point emphatically: "If it is scientific, I believe it. If it isn't, I don't believe it. I don't care who did it, who gives me this information, but if it is scientific, I believe it. I trust it." Moreover, respondents said the science needed to be presented in a way that was "clear," "precise," and "understandable." Two grassroots respondents from New Zealand articulated the importance of making the science locally relevant:

> Respondent 1: If it's scientifically validated… It can't just be any old thing. That's important.
>
> Respondent 2: Right, for example, if [the resource] was validated with a U.S. science thing, I might think, that's not really related to New Zealand.

> Respondent 1: As long as it's got the science, "This is what happens in 90% of disasters around the world," as long as it's communicated that it's well-modeled and it's got the proper statistics in there as well.
>
> ~Grassroots Respondents, Christchurch

The overwhelming majority of respondents in this study were practitioners—not scientists—but they clearly viewed "the science behind the source" as critical to their decisions about adopting new technologies. The team asked follow-up questions during the interviews, which shed light on how the participants evaluated the scientific rigor and quality of new tools or resources.

In the interviews, it was evident that an endorsement of a new tool or resource by trusted organizations and/or trusted individuals with respected credentials made a considerable difference in whether or not the respondents would consider adopting that resource in their professional work.[42] The quotes below highlight this finding:

> If this [information] is sent by professors, the institutions, we know, they are reliable. Kandilli Observatory, we trust the information. Because lots of—we know Mustafa Erdik and also the other professors, so we trust them. They're not political, they're just professors so we trust them.
>
> ~Grassroots Respondent, Antakya

> It's all about connection. If I get a cold call from somebody I don't know, I'll read it once. I might look at their website. I might call them up, highly unlikely though. But if I have that connection with somebody, a peer school or somebody I know well who says, "Hey, check out this resource, this is really worth your time," I'll take the time to do it.
>
> ~Education Respondent, San Francisco

Fortunately, GEM already has developed collaborative relationships with hundreds of organizations globally (in addition, the GHI-CSU team hopes that the trusted organizations and individuals identified in Appendix L of this report will offer candidates for new collaborations). If GEM were to develop new partnerships and to promote those that are already in place, then several of the respondents said that they would feel more comfortable considering GEM's resources. An emergency manager articulated this view:

> Every state has an emergency management agency. CalEMA [California Emergency Management Agency] is here. If you're partnering with them, and they're giving you the connections out to us. That partnership—I assume they've vetted you and that would give [GEM] a little bit of credibility.
>
> ~Government Respondent, San Francisco

Participants also indicated that in order for them to adopt a new tool or technology, they had to be convinced that the new product was "better" than what they were already using. In the quote below, the value of partnering with trusted organizations is again apparent. The respondent

[42] See Appendix L for a city-specific listing of trusted organizations and trusted individuals that were named during the interviews.

indicates that he would be more likely to consider a new resource, if the organization where he usually gets his data were involved in disseminating the resource:

> One of my first questions would be, "Why am I getting data from you as opposed to a federal agency?" That's where I would normally go to get that information. "Why is yours better? If you're there and you're there with somebody from USGS and there's a partnership, okay, I get that." But why is this any better than what's already out there? Maybe you presented it in a better way. That's good. But there's still the quality of data. How do I know if it's any good? I don't.
>
> ~Government Respondent, San Francisco

For respondents from cities in developing countries, the emphasis on partnering with local organizations was not only about building trust: in some cases, it was also about very practical concerns related to the capacity of the public sector to "absorb new technologies and information." In this context, trusted local organizations were sometimes described as potential "bridges" between GEM and decision-makers in local government. A respondent from Bandung communicated this idea:

> First we have to understand local government. In Indonesia, basically, they do not have the capacity to absorb new technologies and information. They are overburdened, overloaded with daily issues of the livelihood of the people. The introduction of new things should in fact offer some kind of communicator. I think the university can work as this agent of introduction because we are respected by the local government, usually. Most of the universities have the required capacity to absorb new technologies and they also have the capacity to communicate with the local government in the user language.
>
> ~Education Respondent, Bandung

In both the large and smaller cities that the team visited, practitioners were well-connected and generally aware of many of the risk reduction programs and activities that their colleagues were leading. Given this, participants thought that it would not only be beneficial, but also time-efficient and cost-effective, for GEM to partner with others. An Istanbul respondent explained:

> In Turkey, there is a group of professionals who are working in this area, and we all know each other. They are all quite accessible, and our number is not that big. Whenever you reach one of us, it means you reach the entire network, I would say.
>
> ~Grassroots Respondent, Istanbul

In addition to partnerships with trusted organizations, respondents indicated that presentation of the resource mattered to them. A grassroots representative from New Zealand said that "the quality of how [a new technology] is presented," influenced her willingness to consider it, because "if it looks sloppy, you think, *whatever*." Some respondents indicated that they would be more trusting of a new technology, if they saw it presented at a local or national conference, where they could "ask questions" and "meet the people" behind it. Similarly, respondents indicated that if GEM were to link its tools and products to government websites or to the websites of trusted organizations, then they might be more likely to consider GEM's resources.

3.3. Risk Communication Strategies

Over the past several decades, social scientists have developed a large body of research evidence that addresses how to communicate risk effectively to practitioners and the public.[43] Research suggests that in order to communicate risk most effectively, GEM should consider the following important factors in conveying risk information:

- Number of communication channels
    - Generally speaking, the more channels (e.g., television, radio, email, etc.) used, the more likely it is that the risk information will reach a wider array of practitioners and, ultimately, the members of the public that they serve.

- Risk information source
    - Risk information should be conveyed by trusted individuals, who are representing credible organizations.
    - No single source or channel will reach a diverse range of people. As such, it is important that multiple sources be used to convey the same information (e.g., a scientist from GEM, a practitioner who uses GEM's products, etc.)

- Communication frequency
    - The more often that risk information is heard and repeated, the more likely it becomes that practitioners and the public will understand the message.
        - Repetition fosters confirmation;
        - Confirmation fosters belief;
        - Belief fosters taking action.

- Content
    - In order to understand risk, practitioners should receive information regarding physical exposure and vulnerability of people and places.
    - When it comes to communicating risk to practitioners, conveying exact statistical probabilities may be less important than communicating how exposure and vulnerability interact to generate higher or lower levels of risk, and what can be done to mitigate that risk.

- Key characteristics of effective risk communication messaging
    - Clear
    - Specific
    - Accurate
    - Certain
    - Consistent

[43] This section draws on a number of scholarly papers and presentations prepared by Dennis S. Mileti, Professor Emeritus in the Department of Sociology at the University of Colorado-Boulder and one of the world's foremost experts on risk communication.

Anup Karanth *is a Senior Consultant at TARU Leading Edge Pvt. Ltd. in Delhi, India, with more than ten years of experience in implementing risk management projects. Anup has been involved in five major earthquakes, where his work has focused largely on assessing damages, estimating housing needs, addressing social issues associated with the earthquakes, and helping governments to provide relief and reconstruction packages. He explains how he uses this information to try to persuade local and state government officials to invest in mitigation: "There is a scope for talking about how you can reduce the risk, more in terms of investment planning. For example, you do an assessment and you know that this is the sort of damage that may occur for a particular event. So you translate that in terms of absolute numbers, in terms of damage, and then ask the government to look into possible mitigation options."*

One major contribution of TARU has been the creation of one of the largest databases of fragility curves for buildings and infrastructure in India. Anup and his colleagues draw from past earthquakes, in order to create simple damage assessment tools that allow users to better understand the potential patterns of damage in earthquakes for specific building types. However, Anup says that one of the key elements missing is micro-zonation maps, which would allow him to calculate risk in Delhi more accurately and offer recommendations accordingly.

Anup has also invested much of his time in trying to communicate about risk to the public, which he says few agencies take as their focus. He and his colleagues volunteer time to serve on committees and to speak in public fora; they contact media outlets to educate journalists on how to cover disasters effectively and extend messaging into the long-term; and they educate students through planning sessions. He explains the need for a hands-on approach to communicating risk: "We actually do a sort of walk-through program with some of the people to take them to some risk-prone areas, show them—tell them how vulnerable the buildings are…We are predicting that over 80% of the buildings are vulnerable to earthquakes." Anup says that there is a misunderstanding about earthquakes and the risks that they pose to each community, "People will not relate to earthquakes happening in Gujarat. And that's the sad part. It's a huge communication challenge. If you tell them, 'Look what is happening in Gujarat, so many people died,' they say, 'Earthquakes happen in Gujarat. They will not happen in Delhi'."

Anup believes that one major way in which GEM can reach people is through contacting universities and providing students with the opportunity to work on customized simulations. "I think some of the tools, like software and other things, could be very, very useful if you take them to the educational institutions," he said. "Today, educational institutions really don't have the sort of tools and materials to understand or quantify seismic risk. It's very essential to reach all possible educational institutions. For the schools, you can have very small simulation-based exercises, where people can just fix up a particular earthquake and see how things will happen in Delhi. The tools will have to be customized… But, it is very important that the tools are not just limited to the engineering side, because most of the tools are limited to engineering colleges, and that doesn't make a lot of sense. They should be shared with the social sciences as well."

Chapter 4 Barriers

Scholars have long been interested in the link between research and practice, and the associated path from *knowledge to action*.[44] One of the core concerns motivating this work is that scientific communities can often be disconnected from the practitioner communities who might use the products developed through basic research. In the past few decades, different models have emerged for connecting these communities and thereby, helping to effectively translate knowledge into action. These processes are typically described as occurring in one of two ways.[45]

The first way, known as the *trickle down model,* holds that good research—and the tools, technologies, and products of that research—will be adopted by practitioners in a relatively straightforward manner, without requiring additional effort on the part of the research community[46] (see Figure 4.1). Those operating based upon this perspective regard the publication of scientific research in peer-reviewed journals as the researcher's "end point." In essence, the conviction is that if the science is innovative and rigorous enough, then the results will eventually be accepted and implemented by end users.

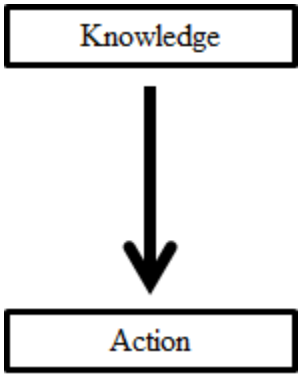


Figure 4.1. Trickle Down Model

The second way, known as the *transfer and translate model,* emerged in response to the perceived failure of trickle down approaches to influence social policy and action.[47] This newer view is predicated on the idea that, rather than waiting passively for end users to implement research findings, researchers should instead work closely with intermediaries or "knowledge translators" in an active effort to transfer their results to users. This model also acknowledges that the products of research must be first adopted on a small scale by so-called "innovators" and "early adopters," before widespread diffusion can occur.[48] The transfer and translate model, like

[44] Everett M. Rogers. 2003. *Diffusion of Innovations.* 5th ed. New York: Free Press.
[45] The background information in this chapter draws heavily from Lorrae van Kerkhoff and Louis Lebel. 2006. "Linking Knowledge and Action for Sustainable Development." *Annual Review of Environmental Resources* 31: 445-477.
[46] Bruno Latour. 1998. "From the World of Science to the World of Research?" *Science* 280: 208-209.
[47] van Kerkhoff and Lebel, 2006, op cit.
[48] Rogers, 2003, op. cit.

the trickle down model, is essentially linear in its view of scientific research and application of results, but it includes a number of additional steps and actors in the knowledge-to-action path (see Figure 4.2).

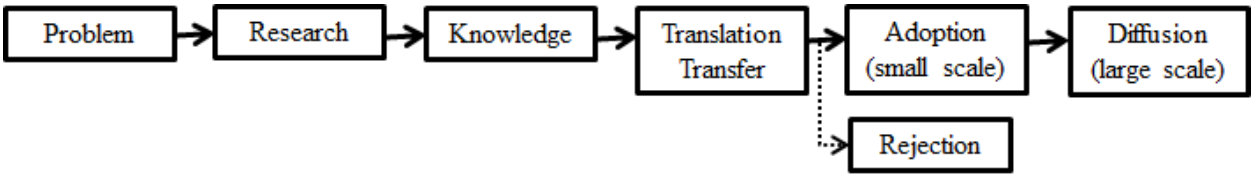


Figure 4.2. Transfer and Translate Model

The transfer and translate model has been widely cited and used by both researchers and policymakers.[49] However, critics assert that the model has many shortcomings, including that: (1) it sees end users as "adopters" or "rejecters" of technology, but not as originators of either technical knowledge or improved practice; (2) it assumes an objective scientific truth that is passed across a direct chain to an end user; (3) it assumes that end users will make rational decisions and adopt new products on a technical basis, but ignores contextual factors that also influence adoption; and (4) it characterizes the main barrier to improved outcomes as being the ignorance of practitioners, which is exacerbated by their poor access to high-quality research results.[50]

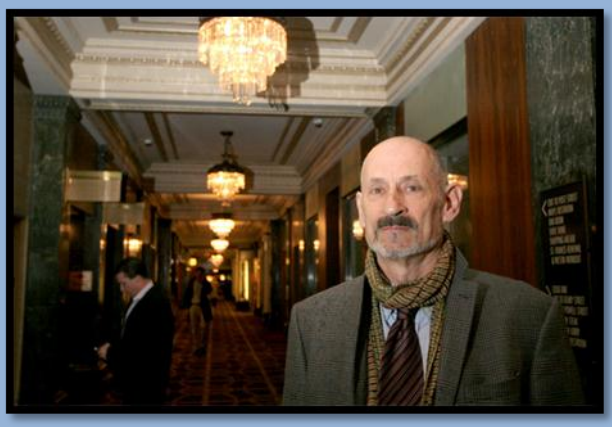
The GHI-CSU team shares these final two criticisms of the transfer and translate model. The team views barriers to earthquake preparedness and mitigation as not just about "ignorance" or "lack of access," but as shaped by a complex and interconnected array of social, cultural, historical, and economic forces. In addition, the team recognizes that knowledge does *not* always lead directly to action. Rather, that knowledge-to-action process involves *developing* and *providing access* to new technologies and resources, *persuading* potential users to adopt the new technology, and *acknowledging* and *overcoming* barriers to adoption. Understanding barriers is thus particularly important, because it helps to explain why even knowledgeable individuals and/or well-resourced organizations may be unable or unwilling to adopt and use a particular technology, such as GEM's risk assessment platform. The following quote underscores this general point:

> Many NGOs came to do diagnostics. I tell everybody, we have kilos of diagnoses. What we are missing is acting and taking action now. So all those organizations have come, the diagnosis is ready and we know that there will be 86,000 fallen homes in an earthquake because this was a city of adobe, and now the desire is to renovate and change this. But right now [Chincha] can't do that so houses continue to be built with adobe. So the micro-zoning soil study has already been done… But now we need to know how intervention can occur.
>
> ~Government Respondent, Chincha

[49] van Kerkhoff and Lebel, 2006, op cit.
[50] van Kerkhoff and Lebel, 2006, op cit., pp. 450-451.

By understanding the barriers frequently encountered by earthquake safety practitioners, GEM will be in a better position to build tools or to offer services that help potential users to promote and implement risk reduction measures.

To assess barriers in this study, the team asked the interview and survey respondents a series of open- and closed-ended questions regarding minor and major barriers to implementing earthquake risk reduction activities in their communities. The following sections summarize the qualitative analyses of the interview data and the quantitative analyses of the survey data, regarding respondents' reported barriers to implementing earthquake risk reduction actions. In each section, commonalities and variance across the 11 target cities and the five sectors are highlighted.



Laurence Kornfield *was the chief building inspector for the San Francisco Department of Building Inspection for twenty years. During that time, he led the Community Action Plan for Seismic Safety (CAPSS) and has since transitioned into working full-time as the manager for the CAPSS program. With a focus on earthquake hazard mitigation, CAPSS is dedicated to educating the community about earthquake risk, informing public policy, updating building codes, and implementing mandates to retrofit the most vulnerable "soft-story" wood frame buildings in San Francisco.*

Laurence understands the need for long-term planning and is currently working on a thirty-year working timeline to present to local government officials in San Francisco. He argues that people underestimate risk and notes that a major earthquake "will be a lot more serious than almost anybody can imagine." Laurence expects that there will be a tremendous amount of public shock in San Francisco after the next large earthquake and that people will ask, "Why didn't you tell us?" Laurence says, "And the whole purpose of our CAPSS impact study is to tell them."

CAPSS was initially funded by the Applied Technology Council (ATC), a state-chartered non-profit group that focuses on translating engineering knowledge into public policy. Even with a million dollar budget, CAPSS faced challenges in gathering adequate data. Laurence explains: "Collecting the data was one of our big problems, because the city does not have a good, integrated department—interdepartmental data collection. So what type of building, how many wood frame apartment buildings of five or more units do we have? It takes a while to coordinate the planning data and the building data and the accessories data. So data collection was a big issue."

Laurence understands that hazard mitigation may always take a backseat to other pressing issues and has dedicated his career to convincing policymakers in San Francisco to shift from a retrospective to a prospective approach to disaster management. Although the funding for CAPSS has expired, he plans to continue his efforts with volunteers and interns and is moving into the next phase of creating implementation and demonstration projects in an attempt "to make public policy real through legislation and other administrative processes." What is most needed now, Laurence explains, is access to information regarding risk communication and best practices from communities around the world.

4.1. Interview Results: Barriers

The team asked two open-ended questions about barriers during the interviews: (1) What barriers have emerged in the course of designing and implementing your earthquake program? (2) Have you changed anything about the program itself or your overall strategy to try to address these barriers?[51] These questions were followed by a series of open-ended follow-up questions meant to draw out more detailed, in-depth responses.

The team analyzed the verbatim transcripts of the 133 interview respondents with two goals in mind. First, the team wanted to use the qualitative data to help further illuminate the general patterns presented in the quantitative analyses, as there was some overlap between the survey items and what respondents discussed during interviews (see section 4.2 below for additional details). Second, the team wanted to analyze the open-ended data provided in the much lengthier and more in-depth interviews, in order to identify additional barriers that had not been included in the survey questionnaire.[52]

Interview respondents across the target cities referred to a total of *49 distinct barriers* to achieving earthquake risk reduction in their communities. Predictably, respondents in cities with the most extreme barriers spoke at greater length and in greater detail about the obstacles that they regularly confront in their professional work. All respondents from all cities, however, identified and discussed barriers in their interviews.

The remainder of this section expands on those interview results. First, Figure 4.3 offers a visual representation of the major themes that emerged in the qualitative analyses of barriers. As Figure 4.3 shows, the GHI-CSU team envisions the knowledge-to-action path as one that is complicated by a number of intervening barriers, at levels that range from the individual to the societal. *One of the reasons why the team does not conceptualize knowledge-to-action as a straightforward, linear path is because it is clear that even the most knowledgeable and informed participants in this study were often unable to overcome the multiple, substantial barriers inhibiting their ability to "get things done."* Indeed, the team interviewed many exceptionally smart, highly-educated, talented, and motivated earthquake safety practitioners, who were desperate to reduce risk in their communities but were stymied time and again by different obstacles. For these and other reasons addressed in the remaining sections of this chapter, the GHI-CSU team views the knowledge-to-action path as a rocky and uneven process.

[51] See Appendix I for the complete interview guide.

[52] The survey was completed at the end of the interview, to ensure that the closed-ended survey responses would not bias the open-ended interview responses.

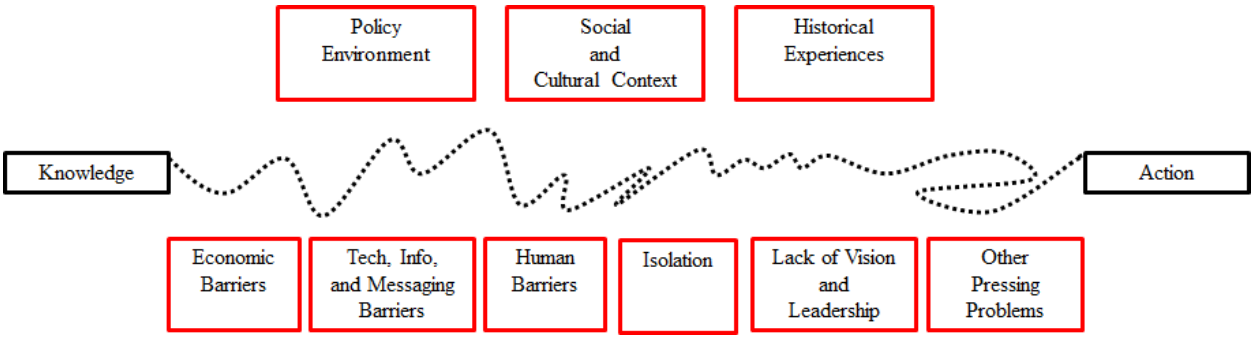


Figure 4.3. Barriers in the Knowledge-to-Action Process

The barriers named in the red boxes in Figure 4.3 represent the nine "meta-themes" that emerged from analysis of the interview data. It is important to note that although Figure 4.3 presents these barriers as distinct from one another, they were often described in interviews as being tightly interconnected and overlapping challenges that obstructed the "knowledge-to-action" path for practitioners. A government official from Delhi, who was representative of many of the respondents in this study, highlighted just how difficult it is to move from planning to implementation, due to multiple barriers:

> If you will allow me to be brutally frank, we are very good at planning, but when it comes to implementation, we tend to be lethargic. The main problem is that immediately when the government took office, and we prepared a national roadmap, I advised the states to prepare state roadmaps [for earthquake risk reduction]. But not much attention is paid to these aspects unless you are also hit by a major disaster. And that is true when you go down to the community level also, because when you hold different types of programs at the community level, it is not taken with that much seriousness, for the simple reason that the other problems of immediate nature, like poverty, unemployment, health issues, they are staring at them, and therefore they look at a possible earthquake or cyclone which will come once in 10 years or 20 years or may even not come in their lifetime, that gets relegated in importance. It is unfortunately when they are struck by such a major disaster that the realization starts seeping in. Therefore those areas which are prone to major disasters but have not suffered a major disaster, it has been a problem to ensure that the awareness seeps in.
>
> ~Government Respondent, Delhi

Table 4.1 summarizes a number of sub-themes that help to elucidate the barrier meta-themes identified above. Within the table, each meta-theme listed in the far-left column has a number of associated sub-themes, which are listed across the same row. The sheer number of sub-themes, and the fact that many respondents discussed multiple obstacles during their interviews, suggest the many challenges *beyond* communicating earthquake risk that GEM is likely to face when attempting to move communities from knowledge of their earthquake risk along the path to action.

Table 4.1. Barriers to Earthquake Risk Reduction: Qualitative Meta- and Sub-Themes (continues on next page)

Meta-Theme	Sub-Themes				
Economic Barriers	limited mitigation program funding	limited private-public insurance coverage	mitigation funds diverted to response	low-income community	large low-income population
Technological, Information, and Messaging Barriers	limited Internet access	inaccessible technical information	lack of historical hazard and technical data to understand risk	inconsistent risk messaging	disconnect between media and disaster orgs
Human Barriers – Professional Staff	lack of time	lack of qualified or experienced personnel	lack of expertise	too few mitigation champions	turnover of key personnel
Isolation	limited networks across hazard-prone communities	limited networks between disaster-focused orgs	limited networks between disaster-focused and non-disaster focused orgs	limited contact between technical experts and community leaders	limited ability of personnel to travel to other similar communities to share knowledge and information
Lack of Vision and Leadership	frequent leadership turnover	lack of focus (too broad or too narrow to effect change)	leaders privilege response activities over mitigation	lack of long-range perspective that mitigation requires	focus on "getting re-elected" as opposed to championing long-term sustainability and other related efforts
Other Pressing Problems Take Precedence over Earthquake Preparedness and Mitigation	social issues (crime, delinquency, homelessness, drugs)	economic issues (poverty, lack of affordable housing)	other more common hazards (e.g., flooding, landslides, pollution)	other more dreaded threats (e.g., infectious disease outbreak, terrorist attacks, nuclear accidents)	infrastructure issues (aging bridges, lifelines, etc.)
Policy Environment	few policy champions dedicated to mitigation lack of evidence-based initiatives	rapidly changing policy environment, focused on policy issues w/ immediate "rewards" as opposed to "long-term benefits and payoffs"	immediate profit valued over long-term culture of safety Lack of assessment of effectiveness of policies, programs, and training initiatives	developers allowed to build unsafe structures due to governmental corruption, short-term profit motives, or a lack of strong policies discouraging such practices	"stove piping" of responsibility across gov't agencies and other orgs;

Table 4.1. Barriers to Earthquake Risk Reduction: Qualitative Meta- and Sub-Themes (continued)

Meta-Theme	Sub-Themes				
Social and Cultural Context	distrust of government and other agencies	uninterested, complacent public	difficult to establish a culture of preparedness when government agencies tend to focus on crisis response	public that prioritizes other issues and concerns above disaster preparedness is difficult to persuade	Difficult if not impossible to reach all people (population is too dense or too sparse; population is too diverse to communicate with vastly different socio-demographic groups, etc.)
	religious fatalism that interprets earthquakes as "God's will' reduces incentive to prepare	lack of awareness and lack of motivation to mitigate earthquake hazards			
Historical Experiences	"hazards memory" is short among public and policymakers	more distant earthquake and lack of experience leads to lack of concern among the public and policymakers	more distant earthquake experience leads to lack of mitigation funding	"old" buildings built before new standards at risk of collapse	meaningful historical structures may not be torn down or retrofitted due to their significant cultural value and/or a lack of an ability to mitigate

4.2. Survey Results: Barriers

In addition to the data collected through the qualitative interviews, the survey included nine closed-ended questions designed to assess respondents' perceptions of barriers to earthquake risk reduction.[53] Potential barrier items were drawn from a review of the empirical research literature regarding obstacles to accomplishing effective earthquake and disaster preparedness and mitigation activities.[54] The survey asked participants to specify whether the following items were a "minor barrier," "major barrier," or "not a barrier" in their professional risk reduction activities:

- Lack of money;
- Lack of time to dedicate to such activities;
- Lack of personnel available to work on such activities;
- Lack of technical expertise;
- Lack of earthquake information;
- Other, more urgent, social or economic problems;
- Other, more serious, hazards;
- Lack of interest in earthquake hazards among colleagues;
- Lack of interest in earthquake hazards among the public.

Table 4.2 presents the analyses of the nine survey barrier items across all 119 survey responses. Although aggregate analyses such as these can mask important differences within the data, they provide the reader with an important "big picture" perspective on reported barriers across the entire sample. More nuanced city-specific and sector-specific responses follow.

Table 4.2 includes barrier response counts and percentages divided by "not a barrier," "minor barrier," and "major barrier" categories. Because the team understands that processing the amount of information in the various data tables in this chapter can be challenging, Table 4.3 simply rank orders the major barriers for all respondents, with "1" being the most commonly cited major barrier and "9" being the least commonly cited.

Tables 4.2 and 4.3 show that a lack of money was the most commonly cited *major barrier* to earthquake risk reduction action, with more than half (53%) of respondents indicating that this was an obstacle. Additional common major barriers included other pressing social and economic problems that divert attention from preparedness and mitigation (50% indicated that this was a major barrier), a lack of available personnel to work on such projects (47% indicated that this was a major barrier), and lack of technical expertise (46% indicated that this was a major barrier). The least common major barrier was a lack of interest among colleagues; more than one-fourth (27%) of respondents indicated that this was an impediment to action.

Although Table 4.2 separates minor and major barriers, one important additional finding to highlight is that over half of all respondents indicated that *all* nine items were either a minor or major barrier.

[53] See Appendix J for the complete survey questionnaire.
[54] For an overview, see: Kathleen Tierney. "Guidance for Seismic Safety Advocates: Communicating Risk to the Public and Other Stakeholders." Buffalo, NY: MCEER. http://mceer.buffalo.edu/publications/Tricenter/04-sp02/2-05tierney.pdf.

Table 4.2. Barriers: Response Counts and Percentages

Barrier Item	Not a Barrier		Minor Barrier		Major Barrier	
	Count (n)	Percentage (%)	Count (n)	Percentage (%)	Count (n)	Percentage (%)
Money	17	14%	39	33%	62	53%
Other social/economic problems	16	14%	42	37%	57	50%
Lack of available personnel	22	19%	39	34%	53	47%
Lack of technical expertise	30	25%	34	29%	54	46%
Lack of interest among the public	31	27%	35	30%	50	43%
Lack of earthquake information	37	32%	39	33%	41	35%
Other serious hazards	34	30%	43	38%	36	32%
Time	29	25%	55	47%	32	28%
Lack of interest among colleagues	52	44%	34	29%	32	27%

Note: Although 119 individuals completed the survey, the counts do not always total 119, because some individuals did not answer all of the survey items.
Note: Percentages reflect rounded estimates and may not sum to 100 percent.

Table 4.3. Major Barrier Response Rank

Barrier Item	Rank
Money	1
Other social/economic problems	2
Lack of available personnel	3
Lack of technical expertise	4
Lack of interest among the public	5
Lack of earthquake information	6
Other serious hazards	7
Time	8
Lack of interest among colleagues	9

Note: 1 = most common barrier, 9 = least common barrier.

4.2.1. Survey Results: Barriers by City

Next, the team analyzed the survey barrier items by city. This analysis revealed striking variance across the 11 target cities in terms of reported barriers to earthdquake risk reduction activities.

Table 4.4 (which spans two pages) summarizes and color codes barrier response counts and percentages by city and for each item on the survey. To read Table 4.4, readers should begin by looking at the far-left column. This column includes a cell for each of the nine survey barrier items. The items are listed in descending order, such that the cell at the top of the far-left column represents the most commonly cited major barrier (money), and the cell at the bottom of the far-left column represents the least commonly cited major barrier (lack of interest among colleagues). When read *horizontally*, the table's numerical data show how many respondents in each city ranked an item as "not a barrier," a "minor barrier," or a "major barrier."

To understand how respondents from a particular city responded to each of the nine survey items, readers should scan the table *vertically.* The 11 target cities are listed across the third row of the table, such that from left to right, respondents reported an increasing number and percentage of major barriers in their city.

The GHI-CSU team identified clear divisions *across the items* and *among the cities* in terms of barriers experienced; this allowed the team to develop a typology of barriers.[55]

Low Barrier Item: 55% or fewer of respondents in a city indicated that the specific survey item (e.g., money, time, lack of technical expertise) is either a minor or major barrier (shown as white cells in Table 4.4).

Moderate Barrier Item: 56-69% of respondents in a city indicated that the specific survey item is either a minor or major barrier (shown as yellow cells in Table 4.4).

High Barrier Item: 70-85% of respondents in a city indicated that the specific survey item is either a minor or major barrier (shown as orange cells in Table 4.4).

Extreme Barrier Item: 86-100% of respondents in a city indicated that the specific survey item is either a minor or major barrier (shown as red cells in Table 4.4).

After analyzing the survey data by each item, the team calculated an *overall barrier percent score* for each city, by adding the minor and major barrier percentages from the total column in Table 4.4. For example, San Francisco had a minor barrier percent score of 36% and a major barrier percent score of 22%, which yielded an overall barrier percent score of 58%. Using this

[55] This classification system—low, moderate, high, extreme—was determined inductively, based on how respondents clustered on particular survey items. Caution should be exercised in inferring categorical difference among items, cities, and sectors that may only be differentiated by a few percentage points.

formula and the above typology, the team then classified each of the 11 target cities into one of the following three[56] categories (see Figure 4.4):

Moderate Barrier Cities: In terms of percentages, survey respondents from **San Francisco** reported the fewest earthquake risk reduction barriers, with an overall percent score of 58% for minor and major barrier items; this was also one of the only cities where respondents reported no extreme barriers across the nine survey items. Respondents from **Istanbul** (66% overall barrier percent score), **Guwahati** (68% overall barrier percent score), and **Christchurch** (68% overall barrier percent score) also reported moderate levels of barriers to earthquake risk reduction.

High Barrier Cities: Survey respondents from **Delhi** (70% overall barrier percent score), **Antakya** (72% overall barrier percent score), **Lima** (75% overall barrier percent score), and **Chincha** (75% overall barrier percent score) reported a high number of barriers to reducing earthquake risk within their cities.

Extreme Barrier Cities: Of all the cities, respondents from **Thimphu** (86% overall barrier percent score), **Padang** (87% overall barrier percent score), and **Bandung** (94% overall barrier percent score) reported the most extreme barriers to earthquake risk reduction. Bandung stands out, in particular: respondents from this city indicated that all nine survey items represented an extreme barrier to earthquake risk reduction. In Thimphu and Padang, respondents said that six of the nine items were extreme barriers, two were high barriers, and one was a moderate barrier. None of the cities in this extreme barrier category reported that any of the items were low on the barrier scale.

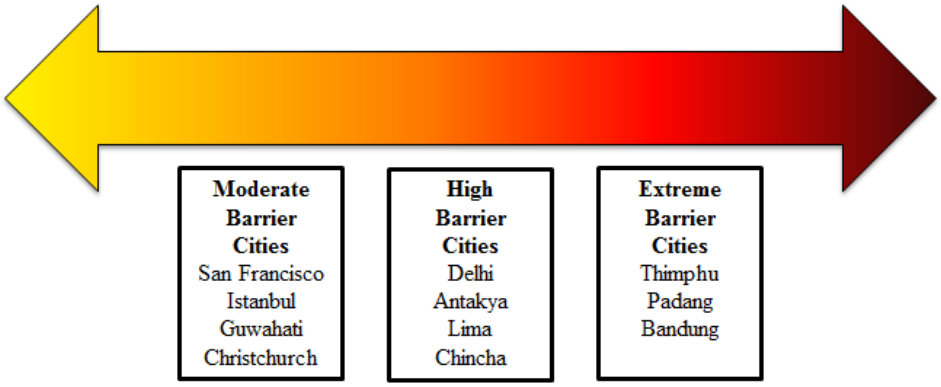


Figure 4.4. Barriers by City

[56] As Table 4.4 shows, some respondents did indicate that particular *survey items* were "low barriers" to reducing earthquake risk. However, none of the cities had a sufficient number of low barriers to warrant being considered a *Low Barrier City.*

Table 4.4. Survey Barriers: Response Counts and Percentages by City (continues on next page)

	City																	
	Moderate Barrier Cities												*High Barrier Cities*					
	San Francisco			**Istanbul**			**Guwahati**			**Christchurch**			**Delhi**			**Antakya**		
Barrier Item	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier
Money	2 18%	4 36%	5 46%	3 30%	3 30%	4 40%	2 25%	4 50%	2 25%	2 13%	6 38%	8 50%	3 27%	4 36%	4 36%	2 22%	2 22%	5 56%
Other social/econ problems	2 20%	6 60%	2 20%	1 11%	4 44%	4 44%	1 14%	3 43%	3 43%	2 13%	6 38%	8 50%	1 9%	6 55%	4 36%	3 33%	1 11%	5 56%
Lack of available personnel	2 20%	4 40%	4 40%	1 10%	3 30%	6 60%	2 29%	1 14%	4 57%	2 13%	7 44%	7 44%	3 27%	3 27%	5 46%	2 22%	2 22%	5 56%
Lack of technical expertise	6 55%	5 46%	0 0%	6 60%	1 10%	3 30%	0 0%	3 43%	4 57%	6 38%	8 50%	2 13%	2 18%	3 27%	6 55%	2 22%	1 11%	6 67%
Public lack of interest	4 40%	4 40%	2 20%	0 0%	1 10%	9 90%	2 33%	3 50%	1 17%	9 56%	4 25%	3 19%	3 27%	3 27%	5 46%	2 22%	3 33%	4 44%
Lack of earthquake info	9 82%	2 18%	0 0%	5 56%	0 0%	4 44%	2 29%	3 43%	2 29%	7 44%	8 50%	1 6%	2 18%	6 55%	3 27%	3 33%	3 33%	3 33%
Other serious hazards	6 60%	4 40%	0 0%	3 33%	3 33%	3 33%	1 14%	1 14%	5 71%	5 31%	9 56%	2 13%	5 46%	5 46%	1 9%	3 38%	3 38%	2 25%
Time	2 18%	3 27%	6 55%	6 67%	2 22%	1 11%	5 63%	1 13%	2 25%	2 13%	7 44%	7 44%	4 36%	6 55%	1 9%	3 33%	3 33%	3 33%
Colleagues lack interest	6 60%	2 20%	2 20%	4 40%	1 10%	5 50%	6 75%	0 0%	2 25%	11 69%	2 13%	3 19%	6 55%	2 18%	3 27%	3 33%	4 44%	2 22%
Total	**39 42%**	**34 36%**	**21 22%**	**29 34%**	**18 21%**	**39 45%**	**21 32%**	**19 29%**	**25 39%**	**46 32%**	**57 40%**	**41 28%**	**29 29%**	**38 38%**	**32 32%**	**23 29%**	**22 28%**	**35 44%**

White: Low barrier, where 55% or fewer respondents indicated that the item is either a minor or major barrier.

Yellow: Moderate barrier, where 56-69% of respondents indicated that the item is either a minor or major barrier.

Orange: High barrier, where 70-85% of respondents indicated that the item is either a minor or major barrier.

Red: Extreme barrier, where 86-100% of respondents indicated that the item is either a minor or major barrier.

Note: Although 119 individuals completed the survey, the counts do not always total 119, because some individuals did not answer all of the survey items.
Note: Percentages reflect rounded estimates and may not sum to 100 percent.

Table 4.4. Survey Barriers: Response Counts and Percentages by City (continued)

	City														
	High Barrier Cities						*Extreme Barrier Cities*								
	Lima			**Chincha**			**Thimphu**			**Padang**			**Bandung**		
Barrier Item	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier
Money	1 7%	4 31%	8 62%	1 10%	4 40%	5 50%	0 0%	2 22%	7 78%	0 0%	3 30%	7 70%	1 9%	3 27%	7 64%
Other social/econ problems	2 14%	2 14%	10 71%	2 20%	3 30%	5 50%	2 25%	4 50%	2 25%	0 0%	2 20%	8 80%	0 0%	5 46%	6 55%
Lack of available personnel	4 36%	3 27%	4 36%	4 40%	4 40%	2 20%	1 11%	3 33%	5 56%	1 10%	4 40%	5 50%	0 0%	5 46%	6 55%
Lack of technical expertise	4 29%	4 29%	6 43%	2 20%	4 40%	4 40%	0 0%	1 11%	8 89%	1 10%	2 20%	7 70%	1 9%	2 18%	8 73%
Public lack of interest	4 29%	5 36%	5 36%	4 40%	2 20%	4 40%	1 11%	4 44%	4 44%	2 20%	2 20%	6 60%	0 0%	4 36%	7 64%
Lack of earthquake info	5 36%	5 36%	4 29%	1 10%	4 40%	5 50%	1 11%	0 0%	8 89%	1 10%	3 30%	6 60%	1 9%	5 46%	5 46%
Other serious hazards	2 17%	4 33%	6 50%	4 40%	5 50%	1 10%	1 11%	2 22%	6 67%	3 30%	1 10%	6 60%	1 9%	6 55%	4 36%
Time	3 21%	7 50%	4 29%	1 10%	7 70%	2 20%	2 25%	5 63%	1 13%	0 0%	8 89%	1 11%	1 9%	6 55%	4 36%
Colleagues lack interest	5 36%	3 21%	6 43%	3 30%	6 60%	1 10%	3 33%	5 56%	1 11%	4 40%	4 40%	2 20%	1 9%	5 46%	5 46%
Total	**30 25%**	**37 31%**	**53 44%**	**22 24%**	**39 43%**	**29 32%**	**11 14%**	**26 33%**	**42 53%**	**12 14%**	**29 33%**	**48 54%**	**6 6%**	**41 41%**	**52 53%**

White: Low barrier, where 55% or fewer respondents indicated that the item is either a minor or major barrier.

Yellow: Moderate barrier, where 56-69% of respondents indicated that the item is either a minor or major barrier.

Orange: High barrier, where 70-85% of respondents indicated that the item is either a minor or major barrier.

Red: Extreme barrier, where 86-100% of respondents indicated that the item is either a minor or major barrier.

Note: Although 119 individuals completed the survey, the counts do not always total 119, because some individuals did not answer all of the survey items.
Note: Percentages reflect rounded estimates and may not sum to 100 percent.

GEM may not be able to reduce all of the barriers identified in this study. But GEM is well-positioned to help practitioners address the barriers of (1) lack of technical expertise (identified as a major barrier by 46% of respondents), and (2) lack of earthquake information (identified as a major barrier by 35% of respondents). For this reason, the team conducted additional city-specific analyses of these two survey items.[57]

Figure 4.5 details, by city, which respondents most frequently reported *lack of technical expertise* as a *major barrier* to risk reduction activities. While less than half of all respondents marked this as a major barrier, responses varied dramatically by location: 90% of respondents in Thimphu cited lack of technical expertise as a major barrier, as compared to 0% of respondents in San Francisco.

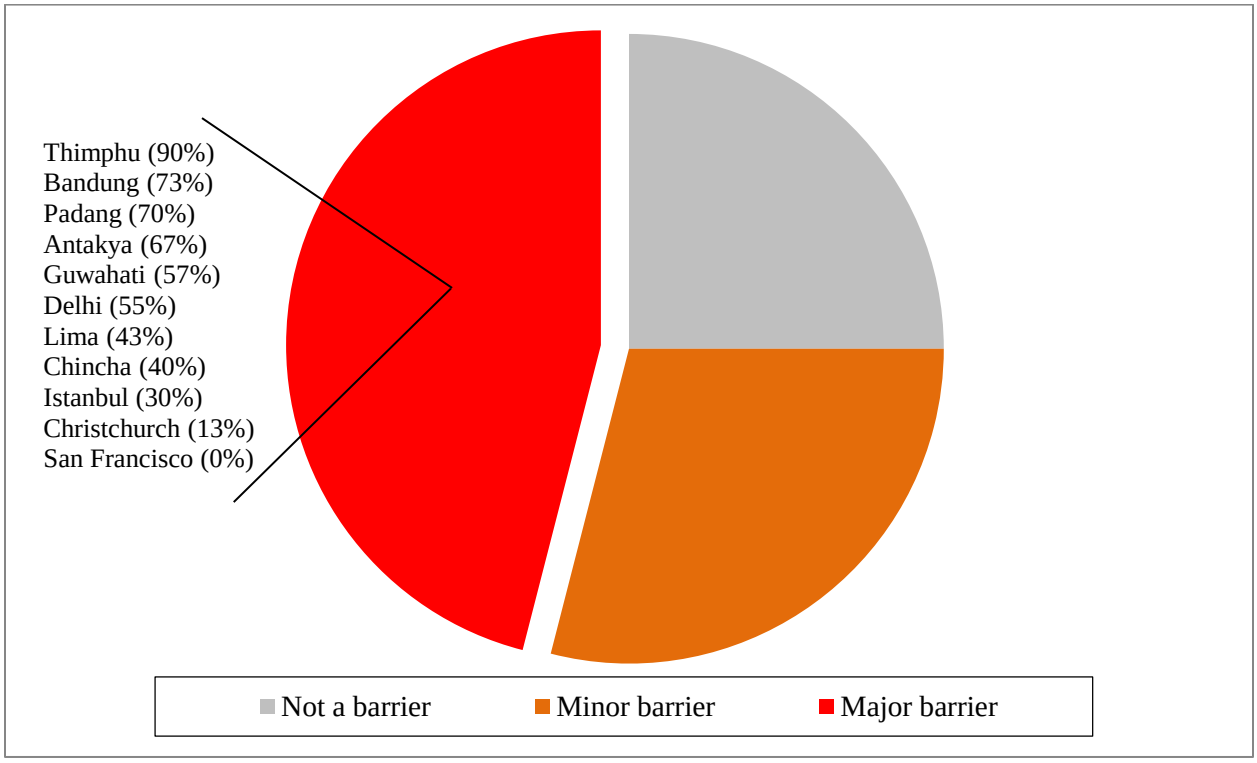


Figure 4.5. Lack of Technical Expertise as a Barrier to Risk Reduction by City

[57] City-specific analyses of all survey items are available upon request.

Figure 4.6 shows, by city, which respondents most frequently reported *lack of earthquake information* as a major barrier to risk reduction activities. A similar pattern to the one displayed above is apparent, indicating that participants in cities in less developed countries experience more difficulty in accessing both technical expertise and earthquake information.

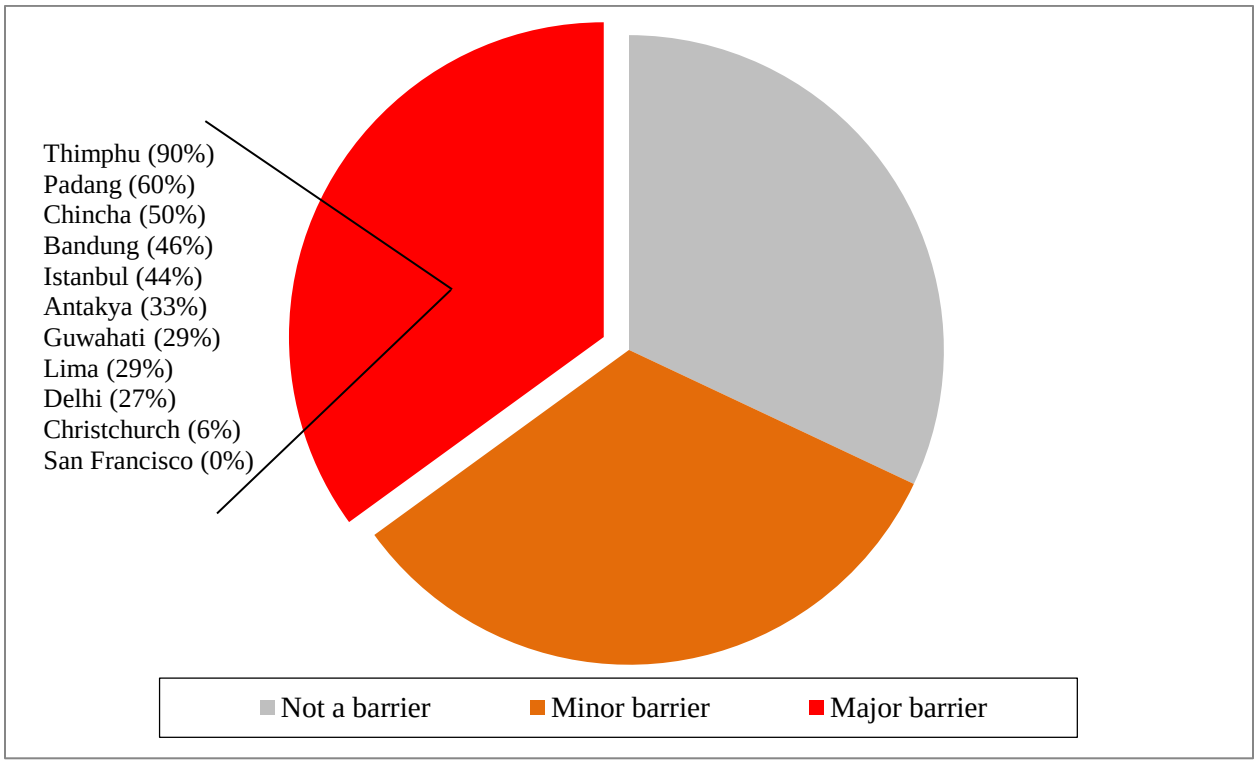


Figure 4.6. Lack of Earthquake Information as a Barrier to Risk Reduction by City

The qualitative data also reveal broad gulfs between target cities, in terms of the amount and quality of information available on local earthquake risk. Consider the difference in how the following two interviewees characterized their access to earthquake information and how they understand their risk. The first respondent is from San Francisco and has a high degree of confidence in the information and data that he obtains from multiple sources and uses on a daily basis in his job:

> Understanding the hazard is very important, so that would be ground shaking and fault lines, landslide, tsunami. Those three are very important to understanding the hazard. [That information comes from the U.S. Geological Survey], pretty much. Impacts on the community, I'm just talking generally, that's important for us. Obviously projected damage to electricity… For predicting damage within [our organization], we have quite a bit of tools. I feel we have a pretty good handle on that. Damage from other infrastructure and community impacts, we rely on Hazus [from the U.S. Federal Emergency Management Agency].
>
> ~Business Respondent, San Francisco

The second respondent explains that the way that she and her colleagues in Padang learned about their extreme hazards risk was through reading a *National Geographic* article:

> Actually, we developed [our program] because of the tsunami in 2004. We found out from *National Geographic* that our city is the riskiest city for tsunami hazard. We know that tsunami is generated from the strong earthquake, so we need to train our people how to mitigate or how to anticipate the earthquake that can generate tsunami. That is the most important thing.
>
> ~Grassroots Respondent, Padang

4.2.2. Survey Results: Barriers by Sector

The team also analyzed the nine survey barrier items (e.g., money, time, lack of technical expertise) by sector. Similar to Table 4.4., Table 4.5 summarizes and color codes barrier response counts and percentages by sector and for each item on the survey.

To read Table 4.5, readers should begin by looking at the far-left column. As in Table 4.4, this column includes a cell for each of the nine survey barrier items. These items are listed in descending order, such that the cell at the top of the column represents the most commonly cited major barrier (money), and the cell at the bottom of the column represents the least commonly cited major barrier (colleagues lack interest). When read *horizontally*, the numerical data show how many respondents, in each sector, ranked an item as "not a barrier," a "minor barrier," or a "major barrier."

To understand how respondents from a particular sector responded to each of the nine survey items, the reader should scan the table *vertically*. The five key sectors are listed across the third row of the table, such that from left to right, respondents reported an increasing number and percentage of major barriers in their professional sector.

The GHI-CSU team identified divisions *across the items* and *among the sectors* in terms of barriers experienced; this allowed the team to develop a typology of barriers.[58]

Low Barrier Item: 55% or fewer of respondents in a sector indicated that the specific survey item (e.g., money, time, lack of technical expertise) is either a minor or major barrier (shown as white cells in Table 4.5).

Moderate Barrier Item: 56-69% of respondents in a sector indicated that the specific survey item is either a minor or major barrier (shown as yellow cells in Table 4.5).

High Barrier Item: 70-85% of respondents in a sector indicated that the specific survey item is either a minor or major barrier (shown as orange cells in Table 4.5).

[58] This classification system—low, moderate, high, extreme—was determined inductively, based on how respondents clustered on particular survey items. Caution should be exercised in inferring categorical difference among items, cities, and sectors that may only be differentiated by a few percentage points.

Extreme Barrier Item: 86-100% of respondents in a sector indicated that the specific survey item is either a minor or major barrier (shown as red cells in Table 4.5).

After analyzing the survey data by each item, the team calculated an *overall barrier percent score* for each sector, by adding the minor and major barrier percentages from the total column in Table 4.5. For example, the grassroots sector had a minor barrier percent score of 36% and a major barrier percent score of 30%, which yielded an overall barrier percent score of 66%. Using this formula and the above typology, the team then classified each of the sectors into one of two[59] categories (see Figure 4.7):

Moderate Barrier Sector: Survey respondents representing the **grassroots** (66% overall barrier percent score) sector reported the fewest barriers to earthquake risk reduction activities.

High Barrier Sectors: Survey respondents representing **education** (71% overall barrier percent score), **business** (74% overall barrier percent score), **government** (78% overall barrier percent score), and **health care** (82% overall barrier percent score) sectors reported a high number of barriers overall to reducing earthquake risk within the context of the organizations and cities where they work.

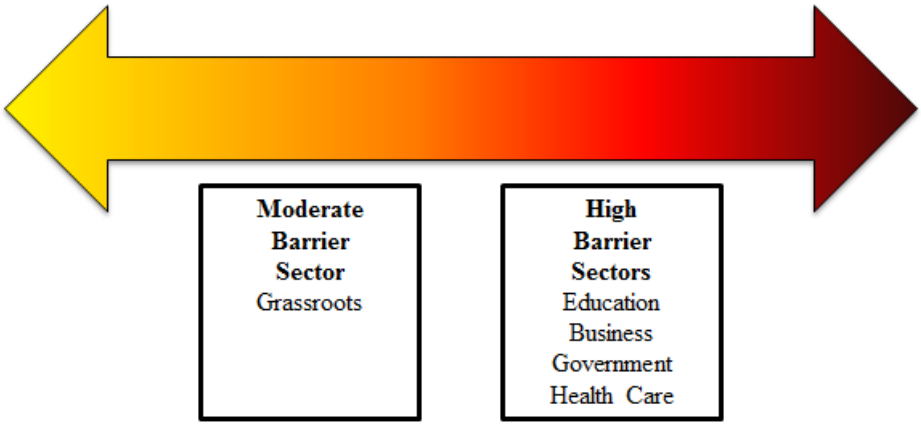


Figure 4.7. Barriers by Sector

When compared to the city-specific analyses presented above, there is far less variability across the five sectors, in terms of reported barriers. This result indicates that *geographic location* has a greater impact upon respondents' reported barriers than does *sector*.

[59] As Table 4.5 shows, some respondents did indicate that particular *survey items* were "low barriers" or "extreme barriers" to reducing earthquake risk. However, taken as a whole, none of the sectors had enough low barriers or extreme barriers to warrant being considered a *Low Barrier Sector* or an *Extreme Barrier Sector*.

Table 4.5. Survey Barriers: Response Counts and Percentages by Sector

	Sector														
	Moderate Barrier Sector			*High Barrier Sectors*											
	Grassroots			Education			Business			Government			Health Care		
Barrier Item	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier	Not a barrier	Minor barrier	Major barrier
Other social/econ problems	5 22%	9 39%	9 39%	4 17%	10 42%	10 42%	3 15%	8 40%	9 45%	1 4%	7 26%	19 70%	3 14%	8 38%	10 48%
Lack of available personnel	10 50%	2 10%	8 40%	6 25%	10 42%	8 33%	4 21%	10 53%	5 26%	2 7%	12 41%	15 52%	0 0%	5 23%	17 77%
Money	3 14%	10 46%	9 41%	4 16%	7 28%	14 56%	2 10%	7 35%	11 55%	6 32%	7 37%	6 32%	2 9%	8 36%	12 55%
Lack of technical expertise	8 36%	8 36%	6 27%	7 28%	5 20%	13 52%	6 30%	2 10%	12 60%	5 17%	14 48%	10 35%	4 18%	5 23%	13 59%
Time	11 50%	7 32%	4 18%	7 28%	14 56%	4 16%	4 21%	10 53%	5 26%	7 24%	12 41%	10 35%	0 0%	12 57%	9 43%
Public lack of interest	7 32%	8 36%	7 32%	7 28%	11 44%	7 28%	6 30%	5 25%	9 45%	6 22%	5 19%	16 59%	5 23%	6 27%	11 50%
Lack of earthquake info	5 24%	10 48%	6 29%	13 52%	7 28%	5 20%	5 25%	4 20%	11 55%	8 28%	11 38%	10 35%	6 27%	7 32%	9 41%
Other serious hazards	8 36%	9 41%	5 23%	8 33%	9 38%	7 29%	7 37%	6 32%	6 32%	5 19%	13 48%	9 33%	6 29%	6 29%	9 43%
Colleagues lack interest	10 44%	8 35%	5 22%	8 36%	4 18%	10 46%	10 44%	8 35%	5 22%	14 50%	6 21%	8 29%	10 50%	4 20%	6 30%
Total	**67 34%**	**71 36%**	**59 30%**	**64 29%**	**77 35%**	**78 36%**	**47 26%**	**60 33%**	**73 41%**	**54 22%**	**87 36%**	**103 42%**	**36 19%**	**61 32%**	**96 50%**

White: Low barrier, where 55% or fewer respondents indicated that the item is either a minor or major barrier.

Yellow: Moderate barrier, where 56-69% of respondents indicated that the item is either a minor or major barrier.

Orange: High barrier, where 70-85% of respondents indicated that the item is either a minor or major barrier.

Red: Extreme barrier, where 86-100% of respondents indicated that the item is either a minor or major barrier.

Note: Although 119 individuals completed the survey, the counts do not always total 119, because some individuals did not answer all of the survey items.
Note: Percentages reflect rounded estimates and may not sum to 100 percent.

The team also conducted sector-specific analyses[60] of the following two barrier items: (1) lack of technical expertise, and (2) lack of earthquake information.

Figure 4.8 details, by sector, which respondents most frequently reported *lack of technical expertise* as a major barrier to risk reduction activities. Fewer than half of all respondents signaled that this was a major barrier, but responses varied widely by sector: 60% of respondents representing businesses, and 59% of those representing health care cited lack of technical expertise as a major barrier, while only 27% of grassroots participants responded in this way.

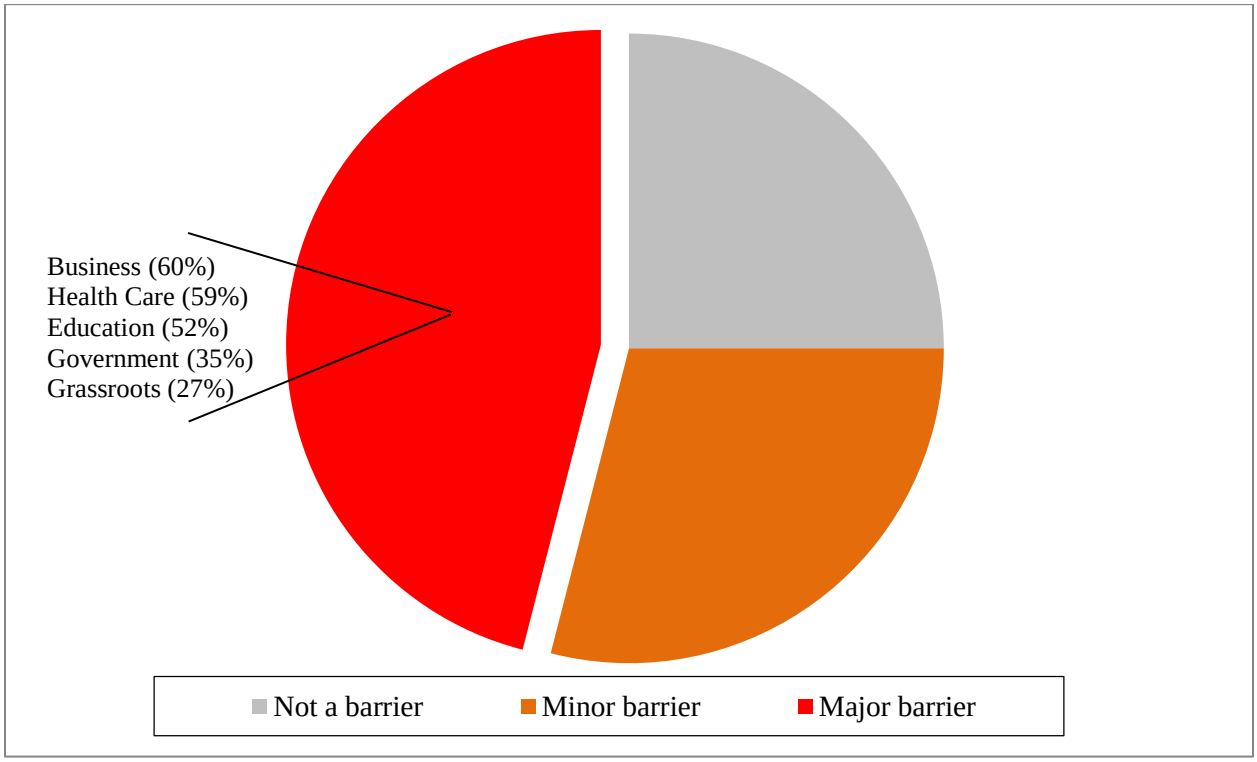


Figure 4.8. Lack of Technical Expertise as a Barrier to Risk Reduction by Sector

[60] Sector-specific analyses of all survey items are available upon request.

Figure 4.9 shows, by sector, which respondents most frequently reported *lack of earthquake information* as a major barrier to risk reduction activities. Respondents representing business (55%) most often cited lack of earthquake information as a major barrier, while those representing education (20%) were least likely to cite this as an obstacle to action.

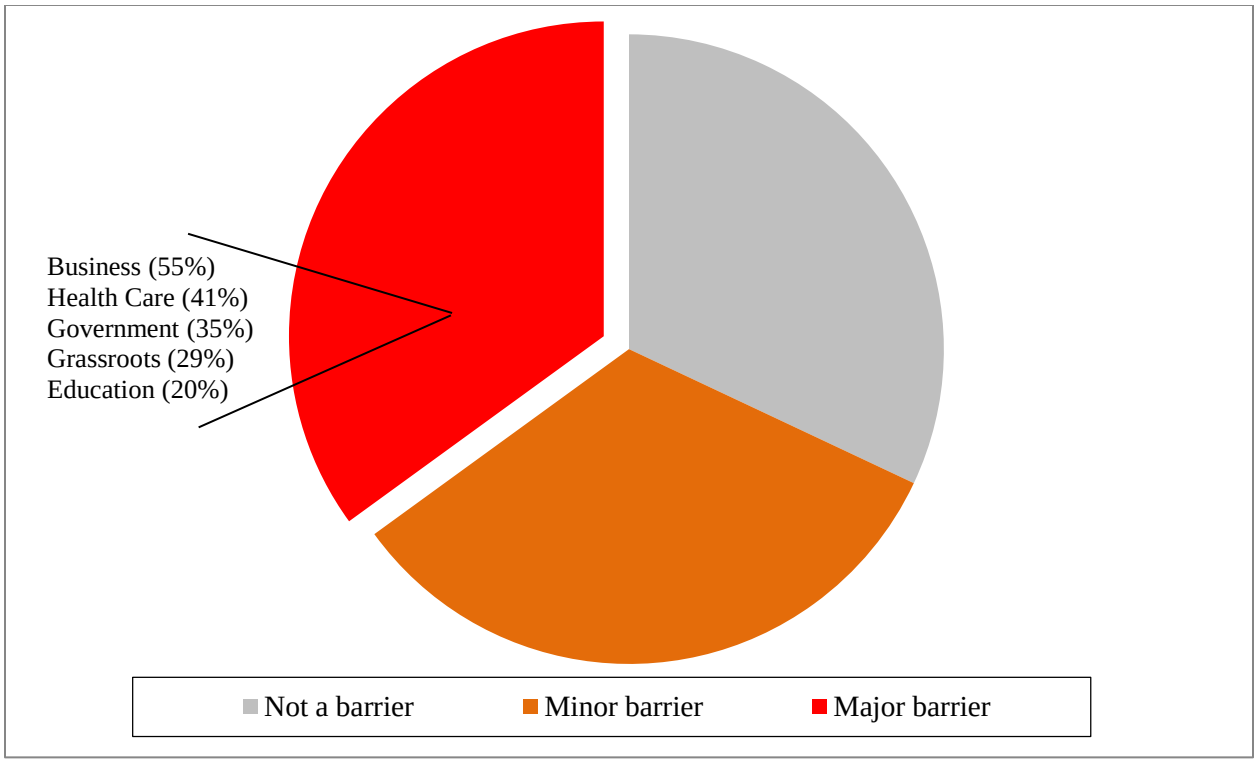


Figure 4.9. Lack of Earthquake Information as a Barrier to Risk Reduction by Sector

4.3 Extending the Data and Findings to Other Cities

The GHI-CSU project team interviewed and surveyed respondents in 11 cities in seven countries. The team's use of a "purposeful sampling procedure"—in which participants were selected based on their knowledge of the research area, their ability to speak on behalf of the sector they represent, and their level of earthquake risk reduction experience in the field—provided data that although not representative, is broadly descriptive of many of the needs and barriers faced by earthquake safety practitioners worldwide.[61]

The project team selected the target cities based on a number of factors, including population size, national income, recency of exposure to a large earthquake, and United Nations' Human Development Index (HDI) score.[62] HDI is a widely-recognized single statistic, expressed as a value between 0 and 1, which serves as a frame of reference for social and economic development. The HDI includes three dimensions (health, education, and living standards) and four indicators (life expectancy at birth, mean years of schooling, expected years of schooling,

[61] See Appendix D for a detailed discussion of the research design and methodological approach for this project.
[62] See Appendix E for a description of the sampling criteria for the cities studied for this project.

and gross national income per capita). Based on those dimensions and indicators, the United Nations rank orders and classifies countries as "Very High," "High," "Medium," or "Low" on the HDI.[63]

The team acknowledges that HDI is not a perfect measure of earthquake risk reduction experience or capacity. But it served as a useful proxy to help the team select cities from a range of development contexts (see Table 4.6).

Table 4.6. List of Target Countries by Human Development Index (HDI)

Target Country (with Target Cities)	HDI Country Score	HDI Country Rank Globally	HDI Country Classification
United States (San Francisco)	.910	#4	Very High
New Zealand (Christchurch)	.908	#5	Very High
Peru (Chincha, Lima)	.725	#81	High
Turkey (Antakya, Istanbul)	.699	#92	High
Indonesia (Bandung, Padang)	.617	#124	Medium
India (Delhi, Guwahati)	.547	#134	Medium
Bhutan (Thimphu)	.522	#141	Medium

In this study, target cities in countries with higher HDI scores tended to have more access to resources and to experience fewer barriers to risk reduction than did cities in countries with lower HDI scores. Within a given country, cities that had larger population sizes and more recent exposure to large earthquakes tended to have more access to resources than did cities with smaller population sizes and more distant exposure to large earthquakes. It should be emphasized that these observed patterns in the cities that the team visited are not statistically generalizable. However, they may provide a useful starting point for GEM as it begins to develop tools for users from various contexts.

[63] More information about HDI can be found at: http://hdr.undp.org/en/statistics/hdi/.

Tutwuri Handayani(pictured left) *is head of disaster management in the Health Department of Padang City, Indonesia. Padang has a high threat of earthquakes, tsunamis, floods, landslides, and volcanos and has experienced many destructive events in the last decade causing significant loss of life and property damage. After attending trainings offered by the Health Department of West Sumatra Province, Tutwuri was inspired to work together with a team to create a contingency plan for hospitals in Padang.*

The contingency plan includes a set of scenarios with potential hazards and their likely impacts. However, since the health department does not have technical resources to determine the effects of a disaster, Tutwuri has had to gather this information on her own. "All of the technical data that [is] in this contingency plan, [I] get together with every single department that is related to this plan, such as the number of schools they have in Padang, I will go to the education department, and find out about the number of people, I go to the statistics department. And I go to the health department to find out about the number of health facilities. Making the scenarios involves working together with other departments."

Tutwuri presents the contingency plan to doctors, nurses, and other staff at local hospitals; however, she is still worried about the lack of information available in the plan, the lack of resources to implement it in an effective way, and the limited capacity of the doctors to handle a large scale disaster.

Acknowledgements

This project would not have been possible without the contributions of many. First, the GHI-CSU team would like to thank the Global Earthquake Model Foundation for the support required to carry out the research and analyses described in this report. Christopher Burton, Nicole Keller, Rui Pinho, and Ross Stein have been especially helpful and encouraging. Chiara Pigoli gave us much-needed advice and assistance in the planning for the 2012 workshop in Pavia, Italy. Leonardo Garrido, formerly of GEM, contributed to the early project planning phases and was an active participant at the first team meeting in Palo Alto, California.

Joan Gomberg of the U.S. Geological Survey generously shared the findings from her own related research and carefully reviewed several project documents. Laura Samant, a consultant and mitigation expert from San Francisco, also presented important research to the project team. Tom Tobin, a senior advisor at GHI, deserves special recognition for his initial input on the project design and careful review of the draft report and of the recommendations presented in this document. Mitch Yawitz, a Silicon Valley-based user interaction designer and engineer, helped the project team better understand the software development process. Mary Comerio, professor of architecture at the University of California-Berkeley, gave valuable feedback on the draft recommendations.

At Colorado State University, John Boyne, Dave Fox, Trent Fugitt, Andy Prelog, and Kelly Renner assisted with the statistical analyses. John Boyne, Ashley Cobb, Alyssa Dawson, Emily Doerr, Bradley Kaye, Kelsea Macilroy, Beth Plombon, Kelly Renner, Claudia Rosty, Stacia Sydoriak, Amber Webb, and Calvin Whitman contributed to the analysis of the qualitative data. Erica Schelly helped with data analysis and the compilation of Appendix L. Kelsea Macilroy, Claudia Rosty, and Stacia Sydoriak carefully proofread the entire document.

Ana Arias painstakingly translated and transcribed the Spanish-language interviews from Peru. Sandy Grabowski transcribed—in record time—the remaining interviews from Bhutan, India, Indonesia, New Zealand, Turkey, and the United States.

The GHI-CSU team benefitted substantially from presenting the preliminary findings of this work in Menlo Park, California (December 2011) and Pavia, Italy (March 2012). Much gratitude goes to the participants at those meetings, who offered crucial feedback.

Finally, the team would be remiss if we did not thank the local partners and the interview respondents from around the globe. These individuals took time out of their busy schedules to meet with us and to share their invaluable insights. We remain fascinated and inspired by the work that these individuals are doing in their communities to reduce earthquake risk. It is our hope that this report accurately reflects their perspectives and conveys their important efforts.

Participants at the *Discovering GEM's Beneficiaries Needs* Workshop
Pavia, Italy
March 2012

Back Row, L-R: Hari Kumar, Sálvano Briceño, Christopher Burton, Mary Comerio, Mona Yolanda, Stasha Wyskiel, Karma Tshering, Lori Peek, Kristen Yawitz, Brian Tucker, Amod Dixit, Anup Karanth, Chris Hawker, and Chiara Pigoli.

Front Row, L-R: Rui Pinho, Ross Stein, Mabel-Cristina Marulanda, Huseyin Nail Kavlakoglu, and Justin Moresco.

List of Appendices

Appendix A – Project Team Bios

GeoHazards International Project Team Members

Verónica Cedillos, P.E., is a Project Manager for GeoHazards International. She received her B.S. in Civil Engineering from MIT in 2005 and M.S. in Civil Engineering from Stanford in 2008. Verónica has over three years' experience in earthquake and tsunami preparedness in emerging countries and one year of experience in structural engineering design work at Gilsanz Murray Steficek in New York City. She has helped to coordinate projects in India, Indonesia, and Peru, and has participated in post-earthquake reconnaissance in China (2008), Indonesia (2009), and Haiti (2010). In India, she investigated the earthquake-resistant features of vernacular architecture in the foothills of the Himalayas, with the long-term goal of promoting these traditional earthquake-resistant techniques for use in current construction practices. At GHI, she has led two major projects—one focused on developing tsunami evacuation solutions, with a particular focus on tsunami evacuation structures for Padang, West Sumatra, Indonesia; and the other focused on improving earthquake safety in rural Peru by conducting trainings on earthquake safe construction and seismically strengthening an adobe school in Chocos, Peru. For the GEM project, Verónica conducted fieldwork in Bandung and Padang, Indonesia and in Chincha and Lima, Peru.

Hari Kumar is India Country Coordinator for GeoHazards International. He is a civil engineer with more than 25 years' experience, 14 of which have been in the field of disaster risk management. Hari has extensive experience in designing and implementing comprehensive school and hospital earthquake preparedness programs. Before joining the staff of GHI, he served as Coordinator of Earthquake Mitigation Programs with the Government of India-United Nations Development Programme (UNDP). He holds a B.E. in Civil Engineering from Mangalore University and an MBA in Disaster Management from Guru Gobind Singh Indraprastha University, Delhi. For the GEM project, Hari conducted fieldwork in Delhi and Guwahati, India and Thimphu, Bhutan.

Justin Moresco, P.E., is a Project Manager for GeoHazards International. A licensed professional engineer, he worked for three years at Degenkolb Engineers in San Francisco, where he designed seismic retrofit schemes for dozens of existing buildings in California. Justin worked as a professional journalist for eight years, writing extensively on the green building industry and international development issues. He has lived and worked in Switzerland and Ghana, West Africa. Justin has a post-graduate diploma in journalism from the London School of Journalism, a M.E. in Civil Engineering with a focus on earthquake engineering from the University of California at Berkeley, and a B.S. in structural engineering from the University of California at San Diego. Justin coordinated the GEM project, led the drafting of the recommendations section, and conducted fieldwork in Antakya and Istanbul, Turkey, in Christchurch, New Zealand, and in San Francisco, in the United States.

Brian Tucker is President of GeoHazards International. His work focuses on preventing avoidable earthquake disasters in the world's poorest countries by using affordable civil engineering practices. Since its founding in 1991, GHI has improved earthquake safety in more than twenty countries. Brian holds a Ph.D. in Earth Sciences from the Scripps Institution of Oceanography at the University of California, San Diego, an M.A. in Public Policy from The Kennedy School of Government at Harvard University, and a B.A. in Physics from Pomona College. He has served as a member of the Board of Directors of the Seismological Society of America. In 2000, Brian was honored for his service to the people of Nepal by the King of Nepal, and in 2002, was named a MacArthur Fellow. In 2007, he received the U.S. Civilian Research and Development Foundation's George Brown Award for International Science and Technology Cooperation and was elected a Fellow of the California Academy of Sciences. He was recently named one of UC San Diego's 100 Most Influential Alumni. Brian is principal investigator on the GEM project.

Kristen Yawitz is Director of Strategic Planning and Development for GeoHazards International, where she collaborates closely with GHI staff and the board on overall strategic direction and growth planning for the organization. Kristen has broad experience in communications, development, writing, and editing and has taught critical thinking, technical writing, and business writing at the university level. A graduate of Swarthmore College, Kristen holds Masters degrees in Literature (Columbia University) and Writing (California College of the Arts). She provided critical feedback on the draft and final reports and served as moderator for the 2012 meeting in Pavia, Italy.

Colorado State University Project Team Members

Michelle Meyer Lueck is a Ph.D. Candidate in Sociology at Colorado State University. She earned her B.A. in Sociology from Murray State University in Murray, Kentucky, and her M.A. in Sociology from Colorado State University. She is currently a research assistant both at the Center for Disaster and Risk Analysis and on a project funded by the National Science Foundation and National Oceanic and Atmospheric Administration, on hurricane risk perception along the U.S. Gulf and Atlantic Coasts. Michelle's dissertation research focuses on the role of social capital in individual and community resilience, and on social vulnerability in hurricane-prone communities. She is recipient of the National PERISHIP Dissertation Fellowship, the Rural Sociological Society Dissertation Research Award, and the Midwest Sociological Society Endowment Committee Award. Michelle's research interests include disaster resilience and mitigation, climate change displacement, environmental sociology and community sustainability, and the interplay between environmental conditions and social vulnerability. She conducted statistical analyses of the surveys for the GEM project.

Lori Peek is Associate Professor of Sociology and Co-Director of the Center for Disaster and Risk Analysis at Colorado State University. She also serves as the Associate Chair for the Social Science Research Council Task Force on Hurricane Katrina and Rebuilding the Gulf Coast. Her work focuses on socially vulnerable populations—including children, women, racial and ethnic minorities, and persons with disabilities—in disaster. She has conducted field research in New York City after 9/11, in Louisiana after Hurricane

Katrina and the British Petroleum oil spill, and in Christchurch, New Zealand, after the 2011 earthquake. She is author of *Behind the Backlash: Muslim Americans after 9/11* (Temple University Press, 2011) and co-editor of *Displaced: Life in the Katrina Diaspora* (University of Texas Press, 2012). In 2012, *Behind the Backlash* was selected as the recipient of the Distinguished Book Award from the Midwest Sociological Society. In 2009, the American Sociological Association Section on Children and Youth honored Lori with its Early Career Award for Outstanding Scholarship. She received her Ph.D. in Sociology from the University of Colorado at Boulder in 2005. Lori led the CSU team and the report writing and data analysis efforts for the GEM project; she also conducted interviews in San Francisco, in the United States.

Liesel Schilperoort is a second-year M.A. student in the Department of Sociology and a research assistant at the Center for Disaster and Risk Analysis at Colorado State University, where she was recently named an International Presidential Fellow. Liesel received a B.A. in Environmental Studies, with an emphasis on Disaster Risk Reduction and Emergency Planning and a minor in Sustainable Design, from Western Washington University. Her research interests include disaster ethnography, vulnerable populations, community and inter-organizational relationships pre- and post-disaster, cultural risk analysis, and the relationships between state, economy, society, and disaster governance. Currently, Liesel is working on her master's thesis, which explores earthquake risk reduction efforts in Turkey. For the GEM project, Liesel conducted interviews in Antakya and Istanbul, Turkey and assisted with the coding of interview data.

Jennifer Tobin-Gurley is a research assistant at the Center for Disaster and Risk Analysis and a second year Ph.D. student in the Department of Sociology at Colorado State University (CSU). She earned her B.A. in Sociology and Women's Studies in 2005 and her M.A. in Sociology in 2008, all from CSU. Her master's thesis research drew on qualitative interviews with local disaster recovery workers and single mothers, who were displaced to Colorado after Hurricane Katrina. Her work on the post-disaster resource needs of single mothers was published in the *International Journal of Mass Emergencies and Disasters.* Jennifer's paper on downward mobility among displaced women received first place in both the 2011 Hazards and Disasters Student Paper Competition and the 2011 U.S. Gender and Disaster Resilience Alliance Paper Competition. For the GEM project, Jennifer conducted interviews in Christchurch, New Zealand and assisted with the quantitative and qualitative analysis.

GHI-CSU Project Team Members
Palo Alto, California
April 2011

L-R: Hari Kumar, Liesel Schilperoort, Lori Peek, Jennifer Tobin-Gurley, Justin Moresco, Brian Tucker, and Verónica Cedillos.

Appendix B – Project Team Contact Information

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Appendix C – Research Timeline

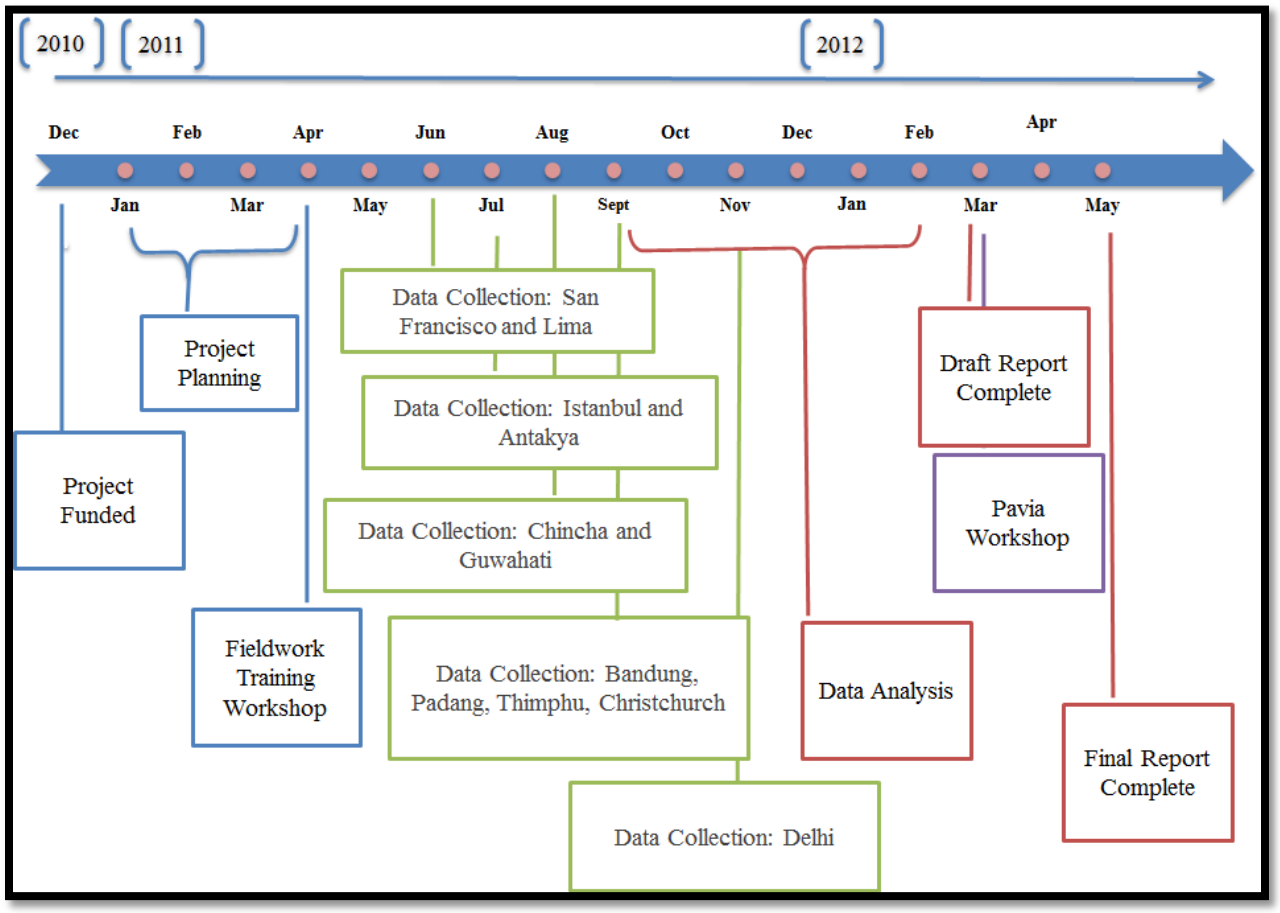

Figure C.1. Research Timeline

Appendix D – Research Design and Data Collection Methods

This research project was designed to answer the following research questions:

- What earthquake risk reduction programs and initiatives are already underway in these communities? What prompted the creation of these programs and initiatives?
- What tools and resources do practitioners currently use to assess and mitigate their earthquake risk?
- What communication channels do these practitioners prefer to use to communicate with colleagues and the public?
- What tools and resources do these practitioners say that they would like to have, in order to better understand and communicate earthquake risk? What functionalities would these practitioners like to see integrated into these tools?
- What barriers do practitioners confront in acting to reduce their communities' earthquake risk? What tools and resources could GEM provide that would help practitioners and community leaders overcome these barriers?
- How can GEM help these practitioners to better understand and mitigate their communities' earthquake risk?
- Which practitioners are most likely to adopt and use GEM's tools?

The 18-month project was divided into three phases. Phase 1 (December 2010-April 2011) was preparatory and focused on building the project team, designing the research and data collection strategy, and training the project team members in field research methods. Phase 2 (May 2011-February 2012) focused on data collection and analysis, including visiting the 11 target cities, conducting interviews and distributing surveys, analyzing the qualitative and quantitative data, and drafting the first version of the report. Phase 3 (March 2012-June 2012) began with a workshop in Pavia, Italy that brought together representatives of GEM, members of the GHI-CSU project team, and community leaders from eight countries. That workshop produced several draft recommendations, which the team integrated into this final report. The project culminated in a presentation of research findings and recommendations to the GEM Secretariat in Pavia, Italy in June 2012.

Research Design and Methodological Approach

A mixed methods approach, which entails gathering qualitative and quantitative data, was best suited for this study, because the study was of moderate size (Surveys: N=119, Interviews: N=133), which made it possible to treat each case as distinct for qualitative purposes and to treat the sample size as large enough for a simple, complementary quantitative analysis.[64]

The purpose of qualitative research methods is to study real people in natural settings, rather than in artificial experimental laboratories.[65] The trend among disaster researchers to use qualitative approaches in data collection is increasing, with in-depth interviews and case studies being the

[64] Charles C. Ragin, Joane Nagel, and Patricia White. 2004. *Workshop on Scientific Foundations of Qualitative Research.* Washington, DC: The National Science Foundation.
[65] Martin N. Marshall. 1996. "Sampling for Qualitative Research." *Family Practice* 13(6): 522-525.

most commonly used qualitative methods.[66] In this project, the GHI-CSU team chose to conduct in-depth interviews[67] with all participants. This responsive interviewing style involves asking open-ended questions and directed follow-up questions, which are designed to evoke nuance and detail in participant narratives.[68] Indeed, the overarching goal of using qualitative methods is to gain an in-depth understanding of the experiences of a small group of research participants—including gathering rich contextual details and exploring related and contradictory themes[69]—rather than a breadth of knowledge that can only be attained through surveying large, representative samples.[70]

The purpose of quantitative research methods is to provide numerical data about a study population. The numerical data are used to test hypotheses, evaluate relationships between phenomena, and generate counts or rates of incidence about a topic from a large number of people.[71] Survey research, in particular, is the most common quantitative method to gather numerical data about individuals' opinions or perspectives on a topic. The GHI-CSU team used surveys to gather opinions about resource needs, information sources used by the participants, and barriers to earthquake risk reduction. The information provided in the surveys allowed the team to perceive general patterns in the responses to these topics—for example, which barriers are most common across cities.

Fieldwork Training Workshop

Prior to visiting the target communities, the GHI-CSU team met at the GHI offices in Palo Alto, California, for a two-day fieldwork training workshop. Two representatives from GEM, Leonardo Garrido and Nicole Keller (via Skype), attended the workshop in order to provide feedback and stay involved in all aspects of the research project. Joan Gomberg, a scientist with the U.S. Geological Survey, and Laura Samant, a consultant from San Francisco, also participated in the workshop and presented findings from the earthquake risk reduction efforts they have been pursuing in their own work.

The first goal of the workshop was to address project logistics, including discussing the research timeline, target communities, potential participants, and local partners. Second, the team addressed a variety of topics related to field interviews: collecting data, using an interview guide, conducting fieldwork, and interviewing diverse individuals effectively. Third, the team focused on analytic techniques related to preparing transcripts and analyzing qualitative and quantitative data. Finally, the GHI-CSU team reviewed project goals and outcomes. The meeting also allowed the project team the opportunity to collaborate to refine the interview guide, survey instrument, and overall research protocol. Because at least one of six researchers from the GHI-CSU project team was assigned to each target community, developing a clear set of guidelines

[66] Robert A. Stallings. 2002. "Methods of Disaster Research: Unique or Not?" Pp. 21-44 in *Methods of Disaster Research,* edited by R.A. Stallings. Philadelphia: Xlibris.
[67] Herbert J. Rubin and Irene S. Rubin. 2012. *Qualitative Interviewing: The Art of Hearing Data.* 3rd ed. Thousand Oaks, CA: Sage Publications.
[68] Rubin and Rubin, 2012, op. cit.
[69] Rubin and Rubin, 2012, op. cit.
[70] Anne-Marie Ambert, Patricia A. Adler, Peter Adler, and Daniel F. Detzner. 1995. "Understanding and Evaluating Qualitative Research." *Journal of Marriage and the Family* 57(4): 879-893.
[71] Floyd J. Fowler. 2009. *Survey Research Methods.* 4th ed. Thousand Oaks, CA: Sage Publications.

for data collection helped to improve the reliability and validity of the data gathered and helped to ensure uniformity across research sites.

Research Instruments

The GHI-CSU project team, in consultation with GEM, drafted a two-page interview guide to be used during the Phase 2 interviews in the 11 target communities. The guide included the open-ended questions to be asked during interviews.[72] One of the hallmarks of qualitative research is that it allows for flexibility in ordering the questions asked, so while all members of the GHI-CSU team asked every question in the guide, they often asked them in a somewhat different order, based on the flow of the conversation. The open-ended interviews varied in length, but the average interview time was about 50 minutes.

In addition to the interview guide, the GHI-CSU team drafted a survey questionnaire, in consultation with GEM.[73] Members of the team edited and revised the first draft of the survey, and then sent it to outside research assistants from CSU. These assistants checked the survey to ensure that the questions were clear, grammatically correct, and appropriate in relation to the research goals. The GHI-CSU team integrated suggested revisions into the final two-page survey, which included 47 questions.

The survey was administered to participants following the interviews. The survey took approximately five minutes for participants to complete. After the participants finished the survey, the interviewer from the GHI-CSU project team asked a final set of open-ended questions, in order to clarify responses and to help evaluate the resource needs of participants. At the end of the interview, the GHI-CSU project team members asked interviewees to fill out a demographic information form[74] and offered them a two-page handout describing GEM's mission and global outreach efforts.

The interview guide, survey questionnaire, and demographic information form were all created in English and, once finalized, were translated into Indonesian, Spanish, and Turkish to meet the language needs of the global participants. One of the responsibilities of the local partner was to translate the interview guide and survey questionnaire and/or to act as an interpreter during the interview. Local partners also "debriefed" with the GHI-CSU team members immediately after each interview. This approach was particularly useful, as it allowed the local partner to act as an interpretive guide and a co-researcher; this practice is highly recommended by social science scholars, to "strengthen the rigor and trustworthiness of qualitative cross-language research."[75]

The project team used a dual translation strategy, which is encouraged in social science research to ensure the accurate translation research instruments. In the case of this project, the GHI-CSU

[72] See Appendix I for the interview guide in English. Indonesian, Spanish, and Turkish language versions available upon request.
[73] See Appendix J for the survey questionnaire in English. Indonesian, Spanish, and Turkish language versions available upon request.
[74] See Appendix K for the demographic information form in English. Indonesian, Spanish, and Turkish language versions available upon request.
[75] Rachel C. Berman and Vappu Tyyska. 2011. "A Critical Reflection on the Use of Translators/Interpreters in a Qualitative Cross-Language Research Project." *International Journal of Qualitative Methods* 10(1): 178-190.

team member and local partner worked together to translate the instruments from English to Indonesian, Spanish, or Turkish, respectively. The original document was then compared to the translated document, so the team could look for "any inconsistencies, mistranslations, meaning, cultural gaps, and/or lost words of phrases."[76] Then together, the translators worked through their differences, agreeing on the best translation for each discrepancy. The translated instrument was then proofread and finalized before being used in the field.

Over the course of this project, the GHI-CSU team developed a number of documents and other materials to systematize data collection efforts. For example, the team drafted a detailed "Fieldwork Guide" that members followed while collecting data. This guide included logistical information regarding what to take to each interview; an outline of key activities to be completed during each interview; and a series of answers to "what to do if…" questions regarding challenges and dilemmas that could arise in the field.

Research Sites

Choosing a sample population is fundamental to the design of any qualitative study, given that researchers can never study *all* people and places.[77] Experts in qualitative research design emphasize the importance of being critical when choosing research sites, in order to increase the quality of the data that is gathered. Scholars working in this area recommend choosing research locations where "(a) entry is possible; (b) there is a high probability that a rich mix of the processes, people, programs, interactions, and structures of interest is present; (c) the researcher is likely to be able to build trusting relationships with the participants in the study; (d) the study can be conducted and reported ethically, and (e) data quality and credibility of the study are reasonably assured."[78] This research literature provided a logical framework with which to begin the city sampling criteria process, outlined in detail in Appendix E.

Prior to initiating the data collection efforts, the GHI-CSU team drafted a 15-20 page "City Document" for each of the target cities. This document included relevant information for each city that team members would visit, including maps, socio-demographic and economic indicators, earthquake information on recent events and levels of seismic risk, earthquake hazards legislation and building codes standards for the city and country, and information on hazards-related public education efforts. These city documents provided important background information and helped to prepare the GHI-CSU team for data collection in each city.

When doing qualitative research, "building flexibility into the research design is crucial."[79] This proved to be particularly true during our efforts to find representative cities. Our initial research design proposed that we would conduct 10 interviews in each of the following 10 cities: Antakya, Bandung, Christchurch, Guwahati, Istanbul, Lima, Padang, Pisco, San Francisco, and Thimphu. However, when one of our project team members entered the field in Guwahati, he

[76] Susan Y. McGorry. 2000. "Measurement in a Cross-Cultural Environment: Survey Translation Issues." *Qualitative Market Research: An International Journal* 3(2): 74-81.
[77] Catherine Marshall and Gretchen B. Rossman. 2011. *Designing Qualitative Research.* 5th ed. Thousand Oaks, CA: Sage Publications.
[78] Marshall and Rossman, op. cit., p. 101.
[79] Marshall and Rossman, 2011, op. cit., p. 90.

quickly realized that participants were unwilling to be audio recorded due to confidentiality concerns, which reduced the amount of data that we could rely on for our results. In order to protect the integrity of the research design, the team collectively decided to add Delhi to the final sample. This had the added benefit of providing new knowledge and contributed to more robust findings. In addition, while another team member was conducting interviews in Lima, she was informed that it would be unsafe to travel to Pisco to carry out the remainder of her research. The city in Peru that was closest to Pisco demographically, and fulfilled all of the criteria listed in Appendix E, was Chincha. Therefore, our final sample was represented by 11 cities in seven countries, spanning five continents.

Piloting San Francisco

In early June 2011, two team members visited the first target community and conducted interviews. The project team used the lessons learned from this first community visit and incorporated them, as needed, into the research protocol—including updates to the interview guide and survey questionnaire—used during the remaining field visits. Pilot studies are recommended to refine research instruments, such as questionnaires and interview schedules, eliminate barriers, foreshadow problems in data collection, and to strengthen issues of research validity, ethics, and representation.[80]

Local Partners and Gaining Access

The GHI-CSU team hired one to two people in each city to act as a local partner.[81] The local partners acted as associates on the ground, with intimate local knowledge of the target city; this helped the project team to gain access to the field setting and to key interview participants. Before being hired, the team screened the potential local partner to ensure that he or she met the following criteria:

1. Intimately familiar with the city's social, economic, and political landscape.
2. Has a strong personal or professional network in at least one, though preferably more, of the project's five key sectors: local government, business sector, health care, education, and grassroots organizations.
3. Has strong knowledge of local disaster risk reduction efforts, and ideally earthquake risk reduction efforts.
4. Speaks the local language fluently.
5. Is proficient in written and spoken English.
6. Has reliable and affordable access to the Internet and has experience using Skype.
7. Owns a mobile phone.
8. Is organized and dependable.
9. Has experience working with international NGOs or development agencies.

The GHI-CSU team budgeted $750 to remunerate the local partner in each city. This fee was meant to compensate the local partner for the time that he or she spent working on the project

[80] Helen Sampson. 2004. "Navigating the Waves: The Usefulness of a Pilot in Qualitative Research." *Qualitative Research* 4(3): 383-402.
[81] Local partners were not used in San Francisco and Delhi because GHI had pre-existing contacts in these cities.

and to cover any travel, communication, or other costs the local partner might incur while performing the job.

The local partners had a range of responsibilities that differed for each city. They scheduled and attended all of the interviews, translated the research instruments and during interviews when necessary, met with the project team members to debrief after each meeting, and participated in a closing interview. The local partner interviews were not audio recorded, but a project team member took detailed notes about the content of the conversation. These notes were later analyzed and integrated into the report. During the field visits, the project team gathered feedback from the local partners on how they (and similarly situated professionals) could potentially be recruited and trained, on an ongoing basis, to use GEM's tools to initiate risk management activities.

Sample Population

For this study, the GHI-CSU project team implemented a purposeful sampling procedure[82] that requires a flexible and pragmatic approach. Participants were not chosen randomly; instead, they were selected based on their knowledge of the research area, their ability to speak on behalf of the sector they represented, and their level of disaster risk reduction experience in the field. Although choosing a random sample would have made the study more statistically generalizable, it "is not the most effective way of developing an understanding of complex issues relating to human behavior."[83] Instead, the sampling strategy was chosen based on the research questions and conceptual framework. This approach generated rich information about disaster risk reduction activities.

The GHI-CSU project team identified five key sectors to study, including: (1) government, (2) business, (3) health care, (4) education, and (5) grassroots or community-based organizations. Practitioners from these sectors broadly represent key potential beneficiaries of GEM, though the GHI-CSU team recognizes that there are others. Data collection resulted in a total of 133 interview participants and 119 completed surveys from the following sectors:

1. Government: 34 Interviews, 29 Surveys
2. Business: 22 Interviews, 20 Surveys
3. Health: 23 Interviews, 22 Surveys
4. Education: 28 Interviews, 25 Surveys
5. Grassroots: 26 Interviews, 23 Surveys

In addition to the interviews and surveys with practitioners that are the focus of this report, during the field visits, the project team met with five local officials from international development organizations including the World Bank, the United Nations Development Programme (UNDP), and the United Nations Children's Fund (UNICEF). The purpose of the meetings was to introduce the officials to GEM and to explore if these agencies might be interested in using GEM's information in their own risk management activities, or if they would

[82] Marshall, 1996, op. cit.
[83] Marshall, 1996, op. cit., p. 523.

fund risk management activities conducted by others. These interviews were not audio recorded, but the project team took detailed notes about the content of the conversation for analysis.

During Phase 1 of the project, the GHI-CSU team conducted four, 30-minute phone interviews in order to (1) explore how Web 2.0 technologies could be used by GEM to promote earthquake risk reduction and (2) prepare for the Phase 2 interviews. Two interviews were conducted with experts in Web 2.0 technologies; both of those individuals were recommended by the GEM Secretariat because of their expertise and familiarity with GEM. The other two interviews were with professionals at the U.S. Geological Survey (USGS) who have experience using Web 2.0 tools, particularly social media, to communicate scientific information to non-technical audiences. These two respondents were recommended by the public relations office at the USGS. The interviews were audio recorded, and the recordings and associated notes were later reviewed to help identify main themes that emerged during the conversations.

Data Collection

Data were collected between June and November 2011. All interviews were audio recorded, so that they could be transcribed verbatim. Each interview lasted approximately 1 hour, with 50 minutes of open-ended questions and 10 minutes to complete the survey and remaining follow-up questions. Each interviewer followed a semi-structured open-ended interview guide, which can be found in Appendix I. This approach allowed for consistency across interviews, while providing enough flexibility so that the participant could frame and structure the responses from his or her own perspective.[84] After each set of interviews was completed, the GHI-CSU team member created an interview matrix that included the name, date, time, and length of the interview. This document was sent with all of the audio files to the transcriptionist, who quickly transcribed and returned the textual data for analysis.

In order to maintain consistency and accuracy across all of the project team members, meetings were held via Skype after each set of interviews had been completed. This allowed the person leaving the field to debrief and share the successes, challenges, and lessons learned in each city, thereby strengthening the approach of the next team member.

Data Analysis

Once the interviews were transcribed, they were uploaded into Atlas.ti, a qualitative data analysis software program. Before beginning the analysis process, researchers at CSU created a codebook. The codebook included a list of potential major themes and initial codes that were likely to emerge from the data, given the research questions and design.[85] Once the coding process began, many more codes were added to the codebook, and new categories were created as new themes emerged.

Three CSU team members used Atlas.ti to code and analyze the interview transcripts. The analysis occurred in three stages: (1) open coding (i.e., searching for the most general themes and patterns that emerge in the data; (2) axial coding (i.e., searching for more generalizable thematic

[84] Marshall and Rossman, op. cit.
[85] Marshall and Rossman, op. cit.

patterns); and 3) representative coding (i.e., selecting interview quotes for inclusion in the written report that are representative of relevant findings).[86]

The survey data were entered into an Excel file and then uploaded and analyzed using Stata/IC 12.1, a quantitative data analysis and statistical software program.

Methodological Challenges

First, a key limitation of this study is that it is not generalizable. Because this project was exploratory, the project team's goal was not to draw a random, representative sample. Indeed, it would have been impossible to do so, as in order for a true random sample to be selected, the characteristics under study of the entire population should be known. This would have required a complete listing of all earthquake safety practitioners in all 11 cities; such lists are simply not available. Thus, for the team's purposes and to answer the research questions, the team used an approach referred to as "key informant sampling." This type of sampling involves identifying and studying "knowledgeable individuals who have special expertise in some area of interest."[87]

Second, an unavoidable barrier when doing research internationally and cross-culturally is that participants will apply different meaning and value systems to interview questions. Similarly, the analysis will be unable to capture all of the variation between participants. Although the GHI-CSU team used rigorous methods when translating the research instruments, concepts may still be lost in translation between the interviewer, the translator/transcriber, and the participant.

Third, although the GHI-CSU team went to great lengths to ensure consistency, such as hosting the fieldwork training workshop in Palo Alto, scheduling frequent Skype calls to debrief findings, and cross-referencing each other's progress, there are inescapable disadvantages to having multiple people conducting research with participants around the globe.

[86] Marshall and Rossman, op. cit.
[87] For further discussion, see Marshall, 1996, op. cit.

Appendix E – City Sampling Criteria

The GHI-CSU team conferred at length, both internally and with GEM staff, on which cities to study for this project. Through these discussions, the team identified 12 criteria, which it used to select the 11 target cities.

1. *World Bank Region*: In accord with GEM's goal of reaching communities worldwide, the GHI-CSU team endeavored to include cities that would represent the following World Bank regions: (1) Sub-Saharan Africa, (2) East Asia and the Pacific, (3) Europe and Central Asia, (4) Latin America and the Caribbean, (5) the Middle East and North Africa, and (6) South Asia. The 11 cities represented in this study covered four of those six regions (with Christchurch and San Francisco being located outside a major World Bank Region). The team chose not to target cities in Africa or the Middle East due to a combination of safety concerns, low seismic hazard, and/or a lack of recent earthquake experience in those regions.
2. *National Income*: The team selected cities to represent a range of national incomes. According to world development indicator rankings of 215 World Bank Atlas economies, the countries in our sample ranged from 18th (USA) to 160th (India) in national incomes.
3. *Population Size*: The team attempted to include both large and less heavily populated cities. City size ranged from 14 million people (Delhi) to 98,000 people (Thimphu).
4. *Recent and Distant Exposure to a Large Earthquake*: The team selected cities with both "recent" and "distant" exposure to large earthquakes, because exposure to damaging earthquakes is important to understanding public perceptions of risk. The exposure times for the selected cities ranged from one year (Christchurch) to more than 100 years (Antakya).
5. *High Seismic Risk*: In order to advance GEM's goal of reaching the most earthquake-prone cities, the team selected areas that have high to very-high earthquake hazard risk.
6. *Earthquake Mitigation Experience*: The countries in the sample were classified either as "mitigation leaders" (New Zealand, USA), as "active" (Peru, Turkey), or as "passive" (Bhutan, India, Indonesia) with regard to mitigation activities. Although no actual mitigation scale exists, the project team used rankings from the Human Development Index (HDI) as a proxy for risk reduction activity, and therefore experience.[88] The final sample ranges from .519 (India) to .907 (USA), with no available HDI information for Bhutan.
7. *Working Environment*: The selected cities had to have (1) a secure working environment and (2) a political environment—such as a stable and semi- or fully-democratic government—that was amenable to the promotion of earthquake risk reduction. Although this involved an admittedly subjective assessment of the environment, this criterion was important to help ensure the safety of the GHI-CSU team members. This criterion also helped the team to select cities in countries where GEM might have a much better opportunity to make inroads with its platform and tools.

[88] HDI is a widely-recognized single statistic, expressed as a value between 0 and 1, which serves as a frame of reference for social and economic development. The team acknowledges that HDI is not a perfect measure of earthquake risk reduction experience or capacity. But it served as a useful proxy to help the team select cities from a range of development contexts. More information about HDI can be found at: http://hdr.undp.org/en/statistics/hdi/.

8. *Grassroots Organizations*: As a way to ensure access to a diverse range of participants representing the interests of various population groups, the team focused on areas where three major grassroots organizations operate: HelpAge International, Huairou Commission, and Plan International. Not all of the cities were chosen based on this criterion, but it provided a useful starting point for making local contacts in many cities.
9. *International Development Organization Offices*: At least some cities had to have regional or country-level representation of major international development organizations, such as the World Bank, in order for the GHI-CSU team to conduct supplemental interviews with development professionals in these organizations focused on risk reduction. These interviews were conducted in Bhutan, Peru, and Turkey.
10. *Local Partner*: Contact with local partners was required in 9 of the 11 cities (due to GHI's many pre-existing professional contacts in Delhi and San Francisco, local partners were not required in those two cities). Thus, another criterion for city selection was that the team be able to identify a local partner who would assist with scheduling and conducting interviews, and, in some cases, provide translation assistance.
11. *GHI Contacts and Experience*: Communities where GHI had reliable contacts and some work experience were preferred if the contacts and experience would likely facilitate the identification of local partners and respondents.
12. *GHI-CSU Staffing*: GHI and CSU staffing availability, geographic familiarity, and foreign language expertise were considered when selecting the communities.

Once the city selection criteria were established, the team created a matrix similar to the one represented below. As cities were considered and then selected to be part of the sample, the matrix was eventually completed.

	Antakya	Bandung	Chincha	Christchurch	Delhi	Guwahati	Istanbul	Lima	Padang	San Francisco	Thimphu
World Bank Region											
National Income											
Population Size											
Recent and Distant Earthquake Exposure											
High Seismic Risk											
Earthquake Mitigation Experience											
Working Environment											
Grassroots Organizations											
International Development Organization Offices											
Local Partner											
GHI Contacts and Experience											
GHI Staffing											

Appendix F – Interview Participants by City

Antakya, Turkey

Interviewee Name and Email	Title and Affiliation	Sector
Ali Hoca hocayapi@yahoo.com	Civil Engineer, Sigma Construction Test Laboratory and Engineering Company	Business
Hakan Uslu usluhakan@engineer.com	Civil Engineer, Sigma Construction Test Laboratory and Engineering Company	Business
Mehmet Alkan beratalk@hotmail.com	Chief, Antakya National Education Directorate	Education
Zeki Huzmeli zeki_ali@windowslive.com	Branch Manager, National Education Directorate	Education
Ibrahim Kafadar ibrahim_kafadar@hotmail.com	Branch Manager, Hatay National Education Directorate	Education
Mustafa Keser mstfksr@hotmail.com	Assistant Director of National Education Directorate, Antakya National Education Directorate	Education
Bestami Misirli bestamimisirli@hotmail.com	Civil Engineer, Hatay National Education Directorate	Education
Isameddin Cecke soguk.tasgg@gmail.com	Geophysical Engineer, Antakya Municipality	Government
Kadim Dogan hatay@lcisleri.gov.tr	Additional Interview: Assistant Deputy Director, Governor of Hatay	Government
Engin Sozer engin_sozer@hotmail.com	Geology Engineer, Antakya Municipality	Government
Mustafa Halil Yuculen hhyucelen@gmail.com	Director of Governorship of Antakya Province Disaster and Emergency Directorate, Governorship of Antakya Province Disaster and Emergency Directorate	Government
Engin/ Murat Alkaya muralkaya@hotmail.com	Geology Engineer, Hatey, The Chamber of Geology Engineers	Grassroots
Selim Harbiyeli harbiyeli_insaat@hotmail.com	Civil Engineer, Union of Chambers of Turkish Engineers and Architects (TMMOB)	Grassroots
Alaattin Ozturk lad.oztrk@hotmail.com	Doctor, Ministry of Health, Antakya Hospital	Health Care
Joseph Naseh jozefnaseh@gmail.com	Former Director, Orthodox Church	Grassroots

Bandung, Indonesia

Interviewee Name and Email	Title and Affiliation	Sector
Edi Gunawan gunbogani@yahoo.com	Sarjana Ekonomi, PT Erad Multi Selaras/ CV Jabar Karya Utama	Business
Faizal Mohideen faizal.mohideen@yahoo.com	Sarjana Ekonomi, PT Erad Multi Selapas/ CV Jabar Kapya Utama	Business
Gatot Tjahyono gatot.tjahyono@yahoo.com	Kadin Indonesia	Business
Dadang Iradi dadangiradi@yahoo.com	Sekretaris Oinas, Dinas Penoioikan Kota Bandung	Education
Krishna Suryanto Pribadi ksuryanto@si.itb.ac.id	Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung	Education
Sardjimi cirateunkulons@yahoo.com	Chief of SDN Cirateun Kulon	Education
Udjwalaprana Sigit	Head of West Java Disaster Mitigation Agency (aka: Badan Penanggulangan Bencana Daerah (BPBD)	Government
Kamalia Purbani kpurbani@yahoo.com	Master of City Planning, Pemeritan Kotu Bandung	Government
Andar Manik andar.manik@gmail.com	General Coordinator, Care of West Java (aka: Jawa Barat Peduli (Jabar Peduli)	Grassroots
Yanti Sriyulianti yantikerlip@gmail.com	Ketua/ Chairlady, Perkumpulan Kerlip and Seknas Sekolam Aman	Grassroots
Tri Wahyu Murni emghasansadikin@yahoo.com	Cardiothoracic Surgeon, Hasan Sadiicin Hospital, Indonesian Society of Critical Care Medicine	Health Care
Ahyani Raksanagara ahyani_raksanagara@yahoo.com	Chief Medical Officer, Department of Health, Bandung	Health Care

Chincha, Peru

Interviewee Name and Email	Title and Affiliation	Sector
Juan Ramón Torres Padilla infraestructura_60@hotmail.com	Industrial Engineer, EPS SEMAPACH S.A. (Municipal Water Supply and Sewerage)	Business
Julián Vilca juilca_58@hotmail.com ItaliaPautico@gmail.com	Head of Production, Italia Racipico S.R.C.	Business
Marcela Goyoneche Ballumbrosio marcelitapiedad@hotmail.com	Director, IEN San Regis	Education
Andrés A. Rojas Matias andrerojas1504@homtail.com	Professor Primary, I.E.P. Nuestra Seniora de Guadalupe	Education
Carmen Rosa Calle Abad crcalle2@yahoo.com coep.chincha@municipalidadchincha.gov.pe	Architect, Technical Secretariat of Civil Defense Chincha, Provincial Municipality of Chincha	Government
Juan Alberto Ventura Casa juan_alberto_ventura_casas@hotmail.com	Mayor, Municipality	Government
Aldo César Bonifacio Castilla abcmat@hotmail.com	Deputy Mayor, Municipality	Government
Teofilo Rolando Palma Quiroz trpalmaq@hotmail.com	Tecnico, COOPI (Cooperazione Internazionale)	Grassroots
Lilian Zamora lzamora@aspem.org.pe liliansrva@gmail.com	Social Work, Aspem-Emergency Solidarity Association	Grassroots
Juan José Espinoza Anyarín mcjuanjose@yahoo.es	Deputy Director, Coordinator COE-Chincha, San Jose Hospital	Health Care
Mariella Talla Condezo dr_mariellatalla@yahoo.es	Surgeon, Tambo de Mora Health Center	Health Care

Note: One participant representing Education requested that his/her name not be used, so the person has been removed from the table.

Christchurch, New Zealand

Interviewee Name and Email	Title and Affiliation	Sector
Paul Lonsdale paul@ccba.co.nz	Central City Manager, Business Association	Business
Peter Townsend petert@cecc.org.nz	CEO, Canterbury Employers Chamber of Commerce	Business
Simon Cruickshank simon.cruickshank@minedu.govt.nz	Regional Property Manager, Ministry of Education	Education
Chris Hawker chris.hawker@canterbury.ac.nz	Group Manager-Facilities and Operational Services, University of Canterbury	Education
Nicholas Pole nick.pole@minedu.govt.nz	Ministry of Education	Education
Helen Grant helen.grant@ecan.govt.nz	Hazard Analyst (Geological), Environment Canterbury (Canterbury Regional Council)	Government
Peter Kingsbury peter.kingsbury@ccc.govt.nz	Principal Advisor-Natural Resources, Christchurch City Council	Government
Jenny Ridgen jenny.ridgen@ccc.govt.nz	Programme Manager-Healthy Environment, Christchurch City Council	Government
Murray Sinclair murray.sinclair@ccc.govt.nz	Manager, Civil Defense and Emergency Management, Christchurch City Council	Government
Sue Wells sue.wells@ccc.govt.nz	Councillor, Christchurch City Council	Government
Thomas McBrearty tom@cancern.org.nz	Chair, CanCern	Grassroots
Marnie Kent marniek@xtra.co.nz	Coordinator, Sumner Community Group	Grassroots
James Young james@jamesyoung.co.nz	Sumner Disaster Relief Response Group	Grassroots
Kim Burgess kim_b@pegasus.org.nz	General Practitioner, Pegasus Health	Health Care
Graeme McColl ilsogno@snap.net.nz	Emergency management Advisor, Ministry of Health	Health Care
Kelly Robertson kelly_r@pegasus.org.nz	Nursing Leader-CPRG, Pegasus Health	Health Care
Philip Schroeder philip@rollmed.co.nz	Doctor, Canterbury Primary Response Group	Health Care

Delhi, India

Interviewee Name and Email	Title and Affiliation	Sector
Anup Karanth anup.karanth@gmail.com	Senior Consultant, TARU Leading Edge Private Limited	Business
Surender Kumar Verma skumarv153@yahoo.com	Deputy Director, Federation of Indian Chambers of Commerce & Industry (FICCI)	Business
Renu Laroiya renudav@yahoo.co.in	Principal, Shaheed Rajpal Dayanand Anglo-Vedic (DAV) Public School	Education
B.K. Sharma bk_sharma12@yahoo.co.in	Principal, Rajkiya Pratibha Vikas Vidyalaya (RPVV) Ludlow Castle School, Rajniwas Marg Delhi	Education
Sampurnananda Mohapatra sampurnteam@gmail.com	Senior Specialist (Earthquake & Tsunami), National Disaster Management Authority	Government
Sreeja Nair sreeja.nidm@nic.in sreejanair22@gmail.com	Assistant Professor, National Institute of Disaster Management, Indian Institute of Public Administration (IIPA) Campus	Government
M.P. Sajnani sajnani@gmail.com	Director, Disaster Management (DM), Ministry of Home Affairs	Government
Manu Gupta manu@seedsindia.org	Executive Director, SEEDS	Grassroots
R. Chandrashekhar cdb@nb.nic.in	Chief Architect, Central Design Bureau (CDB), Directorate General of Health Services (DGHS) Ministry of Health and Family Welfare	Health Care
R.K. Gupta rajanrak@yahoo.co.in	Doctor, Superintendent Bhagwan Mahavir (B.M.) Hospital	Health Care

Note: One participant representing Government requested that his/her name not be used, so the person has been removed from the table.

Guwahati, India

Interviewee Name and Email	Title and Affiliation	Sector
Jayanta Pathak jayanta_pathak@rediffmail.com	Assistant Professor, Department of Civil Engineering, Assam Engineering College	Business
Mohamed Eunus	Commissioner and Secretary of the Education Department, Government of Assam	Education
Manika Goswami	Principal, Maharishi Vidya Mandir Senior Secondary School, Silpukhuri, Guwahati	Education
A.C. Bordoloi	Commissioner and Special Secretary, Public Works Department, Government of Assam (GoA)	Government
Mukta Ram Deka muktaramdeka@gmail.com	Community Officer, Assam State Disaster Management Authority (ASDMA)	Government
Rajesh Dutta	Engineering Technical Officer, Assam State Disaster Management Authority (ASDMA)	Government
Suma Theik theiksuma@gmail.com	Additional Commissioner, Guwahati Municipal Corporation	Government
Geeta Mazumdar Geeta.mazumdar@crs.org	Partner Support Officer, Catholic Relief Services	Grassroots
Ravindranath rvassam@gmail.com ruralvolunteerscentre@yahoo.co.in riverbasinfriends@yahoo.co.in	Director, Rural Volunteers Center, Assam	Grassroots
Prateek Hajela prateek.hajela@gmail.com	Commissioner and Secretary, Health and Family Welfare, Government of Assam (GoA)	Health Care
Pramode Chandra Hazarika dr.pchazarika@gmail.com	Additional Director, Health Services, Government of Assam, Directorate of Health Services	Health Care

Istanbul, Turkey

Interviewee Name and Email	Title and Affiliation	Sector
Ismet Gungor ismet.gungor@eurekosigorta.com.tr	Coordinator TCIP, TCIP-Turkish Compulsory Insurance Pool	Business
Eren Kalafat eren.kalafat@ulusyapi.com	President, ULUS Construction Company	Business
Selim Kacmazoglu skacmazoglu240@hotmail.com	Expert of Civil Defense, Istanbul National Education Directorate	Education
Mahmut Bas mahmut.bas@ibb.gov.tr	Director, Istanbul Metropolitan Municipality, Directorate of Earthquake and Soil Research	Government
Tezcan Bucan tezcan.bucan@istanbuladm.gov.tr	Branch Manager, Governorship of Istanbul Provincial, Disaster and Emergency Department	Government
Necmi Ercin necmi.ercin@istanbuladm.gov.tr	Department Chief, Governorship of Istanbul Provincial Disaster and Emergency Department	Government
Osman Kilic osman.kilic@ibb.gov.tr	Deputy Director, EQ and Soil Research, Istanbul Metropolita Municipality	Government
Mustafa Elvan Cantekin elvan.cantekin@magvakfi.org.tr	General Director, MAG (Neighborhood Disaster Volunteers) Foundation	Grassroots
Ali Nasuh Mahruki nasuh@nasuhmahruki.com	President, Akut Search and Rescue Association	Grassroots
M. Turkay Esin drturkeyesin@gmail.com	Responsible for Health Services Unit for Disaster, Istanbul Health Directorate	Health Care
Huseyin Nail Kavlakoglu hnk@ttmail.com	Doctor, Tuberculosis Prevention and Treatment Center	Health Care

Lima, Peru

Interviewee Name and Email	Title and Affiliation	Sector
Hans Berger hberger@luzdelsur.com.pe	Subgerente de Nelacoonas Corporativas, Luz del Sur	Business
Cecilia Rosell Grijalba crosell@sni.org.pe	Manager, Committee on Social Responsibility, Environment and SSO, National Society of Industries	Business
Andrea Tang atang@sni.org.pe	Analyst of Accountability Partner, National Society of Industries	Business
Esperanza Moreno Carrera emorenoac@hotmail.com, emorenoac@yahoo.es	Teacher, Heroinas Toledo	Education
Carmen Rosa Suarez Herrera heroinascar@hotmail.com	Teacher, Heroinas Toledo	Education
Miguel Estrada Mendoza estrada@uni.edu.pe	Research Director, National University of Engineering	Education
Jorge Luis Chumpitaz Panta jchumpitaz@minedu.gob.pe	Coordinator of Environmental Education, Department of Community and Environmental Education	Education
Carlos Zavala czavala@amauta.rcp.net.pe czavala@uni.edu.pe	Director, National University of Engineering	Education
Jose Antonio Vargas Via javargas@munlima.gob.pe	Via Architect, Development Manager Urban Metropolitan Municipality of Lima	Government
Red Yul Sanchez Cordenas redcato@gmail.com	Sociologist, Institute for Integral Development	Grassroots
Castorina Villegas Lopez casto_1967_05@yahoo.es castorina@hotmail.com	Coordinator, Women United for a Better People	Grassroots
Pedro Ferradai Mannucci pferradas@yahoo.co.uk pedrof@sducioreipracticas.org.pe	Risk Management and Adaptation to Climate Change Program, Practical Action	Grassroots
Mario Wilfredo Palomino Rivera mwpalomino@gmail.com	Business Administrator, NGO, Instituto Integral Development (IDEI)	Grassroots
Carlos Malpica Coronado cmalpicac@gmail.com	Executive Director, Office of Civil Defense Mobilization and the Ministry of Health	Health Care
Julio Quijano Villaorduna juquivi1@gmail.com jquijanov@minsa.gob.pe	Sociologist, Ministry of Health (General Bureau of National Defense)	Health Care

Note: Three participants—one representing Government and two representing Health Care—requested that their names not be used, so those persons have been removed from the table.

Padang, Indonesia

Interviewee Name and Email	Title and Affiliation	Sector
Ahmad Firdaus ahmad.firdaus@semenpadand.co.id	Safety Environment Chief, IR, Semen Padang	Business
Setia Welly setia64@telkom.co.id	Manager of Telkom for West Sumatra, Telekomunikasi Indonesia	Business
Elivia Murni	Teacher, Guru, SDN 28 Padang Sarai School	Education
Hudi Aningskar Widayanto smapertiwisatupadang@yahoo.co.id	Vice Head School Headmaster and Supervisor of Disaster Mitigation Activities, Sarjana Dendidikan, SMA Pertiwi School	Education
Henky Mayaguezz hmayaguezz@gmail.com henkymayaguezz@yahoo.com	Chief of Rehabilitation Section, National Disaster Management Agency for Padang City (BPBD), Kasi Rehabiliasi, BPBD Kota Padang	Government
Asnul Za asnulza@yahoo.id.com	Head of Building Plan Division, Public Works, Kepala Bidang Ciptakarya Dinas Pu Padang, Dinas Pekerjaan Umum Padang	Government
Syafrimet Azis syafrimet_azis@yahoo.com	Executive Director Nuwirman, Board Member, Jemari Sakato	Grassroots
Patra Rina Dewi patrarinadewi@gmail.com	Executive Director, Komunitas Siaga Tsunami (Kogami)	Grassroots
Imran Sarimudanas imran_sarimudanas@yahoo.co.id	Program Manager, Board Member, Jemari Sakato	Grassroots
Syaiful Saarim saaninsyaiful@lycos.com	Neurosurgeon, Jamil Hospital	Health Care

Note: One participant representing Health Care requested that his/her name not be used, so the person has been removed from the table.

San Francisco, USA

Interviewee Name and Email	Title and Affiliation	Sector
Kent Ferre ksf1@pge.com	Acting Director, PG&E Geosciences	Business
Stasha Wyskiel stasha_wyskiel@gap.com	Manager, Business Continuity Planning, Gap, Inc.	Business
Dan Dworkin dworkin@hamlin.org	Director of Safety and Technology, The Hamlin School	Education
Walter Patrick patrickw@sfusd.edu	Director of Emergency Planning and Preparedness, San Francisco Unified School District	Education
Carla Johnson carla.johnson@sfgov.org	Access Compliance/ Emergency Planner, Mayor's Office on Disability, City and County of San Francisco	Government
Bijan Karimi bijan.karimi@sfgov.org	Emergency Services Manager, San Francisco Department of Emergency Management	Government
Laurence Kornfield laurence@kornfield.org	Project Manager, CAPSS Implementation Program, City and County of San Francisco	Government
Alessa Adamo alessa@sfcard.org	Executive Director, SF CARD	Grassroots
G.L. Hodge ghodge6982@aol.com	Administrator, Providence Baptist Church of San Francisco	Grassroots
Tomas Aragon tomas.aragon@sfdph.rg	Health Officer, San Francisco Department of Public Health	Health Care
Lann Wilder lann.wilder@sfdph.org	Emergency Management Coordinator, San Francisco General Hospital and Trauma Center	Health Care

Thimphu, Bhutan

Interviewee Name and Email	Title and Affiliation	Sector
Namgyal Lhendup nlhendup@druknet.bt	Chief Executive Officer, Royal Insurance Corporation of Bhutan, Ltd.	Business
Phub Tshering phubt@druknet.bt	Secretary General, Bhutan Chamber of Commerce and Industry	Business
Kinley Pem deopung@druknet.bt	Principal, *Lungtenzampa Middle Secondary School*, Ministry of Education	Education
Kaka Tshering katshering@yahoo.com	Liaison Officer, School Liaison and Coordination Unit (SLCU), Department of School Education (DSE), Ministry of Education (MOE)	Education
Kinlay Dorjee thrompon@gmail.com	Mayor, Thimphu Municipality	Government
Namgay Wangchuk nwangchuk@mohca.gov.bt	Director, Department of Disaster Management	Government
Sonam Pelden spelden_5@yahoo.com	Project Officer, Child Centered Disaster Risk Reduction (CCDRR), Save The Children Bhutan	Grassroots
Sonam Tshewang	Save the Children	Grassroots
Garab Dorji Namgyel	Save the Children	Grassroots
Ngawang Dorji ndorji@health.gov.bt	Chief Program Officer, Department of Medical Services, Ministry of Health	Health Care
Dorji Wangchuk drdorjiw@health.gov.bt	Director General, Department of Medical Services, Ministry of Health	Health Care

International Organization Interview Participants

Interviewee Name and Email	Title and Affiliation
Anne Erica Larsen anne.larsen@undp.org	Programme Analyst, Bhutan, United Nations Development Programme (UNDP)
Bishnu Mishra bbmishra@unicef.org	Education Officer, Bhutan, United Nations Children's Fund (UNICEF)
Ruby Noble	Education Specialist, Bhutan, UNICEF
Gustavo Perochena gperochnameza@worldbank.org	Project Coordinator, Water and Sanitation Program, Peru, World Bank
Mara Warwick mwarwick@worldbank.org	Country Sector Coordinator for Sustainable Development, Turkey, World Bank

Note: One participant—representing the World Bank in Peru—requested that his/her name not be used, so this person has been removed from the table.

Web 2.0 Interview Participants

Interviewee Name and Email	Title and Affiliation
Paul Earle pearle@usgs.gov	Director of Operations, National Earthquake Information Center, U.S. Geological Survey
Scott Horvath shorvath@usgs.gov	Web and Social Media Officer, U.S. Geological Survey
Todd Khozein Todd.khozein@secondmuse.com	Founder, SecondMuse
Ed Parsons eparsons@google.com	Geospatial Technologist, Google, Inc.

Appendix G – Local Partner Bios

Antakya and Istanbul, Turkey

M. Ezgi Bakir graduated from Istanbul University with a degree in Geophysical Engineering in 2008. She is currently a Master's student at Bogazici University, Kandilli Observatory and Earthquake Research Institute (KOERI), Department of Geophysics. She is a Basic Disaster Awareness Educator, who helps raise awareness of earthquake risk while encouraging earthquake preparedness through the Disaster Preparedness Education Unit at KOERI. She recently participated as an educator in the North Anatolian Fault Zone Truck project and is a member of the Chamber of Geophysical Engineers in Turkey, the Bogzici University Engineering Society, and the American Geophysical Union. Ezgi's research interests are in seismology, nuclear explosions, ambient seismic noise, and noise analysis of seismic arrays. For the GEM Project, Ezgi served as the local partner for Antakya and Istanbul and assisted Justin Moresco and Liesel Schilperoort with translation, conducting interviews, and distributing surveys.

Seyhun Püskülcü, M.Sc., is the Coordinator of Training Programs at the Disaster Preparedness Unit of the Kandilli Observatory and Earthquake Research Institute (KOERI). A geophysical engineer, she has twenty years of experience in seismology and disaster preparedness. She currently coordinates activities at KOERI's earthquake park, where more than 3,700 students receive training in earthquake awareness and preparedness every year. She also manages the instructor training program and is working on developing and evaluating new educational programs in disaster risk management. Seyhun is involved in several projects focused on disaster preparedness and risk assessment, including the Earthquake Sensibility Days project, the Mobile Earthquake Simulation Training Truck project in collaboration with the Natural Disaster Insurance Foundation, the ENABIS (Disabled Disaster Information System) project in collaboration with the Nilufer Municipality in Bursa, and the SISMILE (Increase Vocational Skills to Face Earthquake Risk Inside of Buildings) European Union Lifelong Learning program, which is a *Leonardo* da *Vinci Development of Innovation project.* For the GEM Project, Seyhun advised Ezgi Bakir on making contacts and arranging interviews in Antakya and Istanbul.

Bandung, Indonesia

Anin Utami, M.T., is a researcher at the Research Center for Disaster Mitigation-Institut Teknologi Bandung (RCDM-ITB). She received her B.S. in Civil Engineering from Sriwijaya University in 2001, and M.S in Construction Management and Engineering, Civil Engineering from Institut Teknologi Bandung in 2004. She has worked at RCDM-ITB since 2003. She has been involved in several research projects related to disaster preparedness and mitigation, such as the Earthquake School Preparedness Program (2001-2007), Developing Community Based Disaster Risk Reduction in Aceh and West Sumatra Province (2006-07), Drill for End to End Simulation on Tsunami Early Warning Systems (2007), Baseline Study on Disaster Risk Reduction Public Education (2008),

Developing Community Based Flood Early Warning Systems in South Jakarta Sub District (Program for Hydro-Meteorological Risk Mitigation in Secondary Cities in Asia, PROMISE-Indonesia), Surveys on Earthquake Resistance Building Risk Perception in Indonesia, Developing an Emergency Operation Plan for Disaster Management in West Java Province, and others. She currently helps RCDM-ITB in conducting research related to earthquake fatalities and damage modeling. For the GEM Project, Anin served as the local partner for Bandung and assisted Verónica Cedillos with translation, conducting interviews, and distributing surveys.

In In Wahdiny, M.T., is a researcher at the Research Center for Disaster Mitigation-Institut Teknologi Bandung (RCDM-ITB). She received her diploma in Communication Science from Padjadjaran University Bandung in 1996 and a Master's in Development Study from Intitut Teknologi Bandung in 2008. In In has ten years of experience in disaster mitigation and disaster education. She has been involved in many research and study activities including, among others, the Indonesian Urban Disaster Mitigation Project (2000-2003), the Earthquake School Preparedness Program (2001-2007), the Drill for End to End Simulation on Tsunami Early Warning Systems (2007), and the Baseline Study on Disaster Risk Reduction Public Education (2008). In these and other projects, she focused on developing educational materials into user-friendly materials for disseminating to local schools and the general public. She currently helps RCDM-ITB in conducting research related to earthquake fatalities and damage modeling. For the GEM Project, In In served as the local partner for Bandung and assisted Verónica Cedillos with translation, conducting interviews, and distributing surveys.

Chincha, Peru

Leticia Quispe Torres lives in the district of El Carmen, province of Chincha Alta, Ica Region, in Peru. She studied nursing in the jungles of Peru at the University of Ucayali. After graduation, she worked for three years as a parent-caregiver in the Wawawasi Program, a social program of the Ministry of Women that works to ensure the welfare of children in Peru. Leticia and her family survived the 2007 earthquake and in the aftermath, met many professionals working in non-governmental organizations (NGOs) seeking to help those affected by the disaster. As a consequence of these contacts, Leticia eventually joined the NGO ITDG Practical Solutions. In this position, she provided technical advice during the reconstruction of Chincha. For the GEM Project, Leticia served as the local partner for Chincha and assisted Verónica Cedillos with conducting interviews and distributing surveys.

Christchurch, New Zealand

David Johnston, Ph.D., is a senior scientist at GNS Science (New Zealand's Geological Survey) and director of the Joint Centre for Disaster Research in the School of Psychology at Massey University, Wellington. The Centre is a joint venture between Massey University and GNS Science. His research has developed as part of multi-disciplinary theoretical and applied research programme, involving the collaboration of physical and social scientists from several organizations and countries. His research

focuses on human responses to volcano, tsunami, and weather warnings, crisis decision-making, and the role of public education and participation in building community resilience and recovery. David is a member of the Scientific Committee for the Joint International Council for Science (ICSU) and the International Social Science Council (ISSC) Integrated Research on Disaster Risk (IRDR); the Royal Society Social Science Advisory Panel; and the Editorial Board of *The Australasian Journal of Disaster and Trauma Studies.* For the GEM Project, David served as the local partner for Christchurch and assisted Justin Moresco and Jennifer Tobin-Gurley with making contacts and setting up interviews.

Delhi, India

Hari Kumar, a GHI staff member who lives in India, coordinated and conducted all of the interviews in Delhi. Given Hari's extensive professional network within Delhi, the project team did not work with a local partner in this city.

Guwahati, India

Nandita Hazarika is the State Project Officer for the Disaster Risk Reduction Project of the United Nations Development Program (UNDP) currently being implemented in Assam, India. She is a civil servant of the Government of Assam with 20 years of experience in different areas relating to public service. She is also a master trainer of the Government of India, a role that has allowed her to develop various training modules, including one on Gender and Disaster Management published by the Ministry of Home Affairs, Government of India, and UNDP. She has also conducted a Training Needs Assessment of the Mauritius Civil Service and trained the Afghanistan National Disaster Management Authority officials on Gendering Disaster Risk Reduction. For the GEM Project, Nandita served as the local partner for Guwahati and assisted Hari Kumar with conducting interviews and distributing surveys.

Lima, Peru

Luz Maria Sanchez Hurtado, an architect by profession, is Executive Director of the non-governmental organization Estrategia (Research and Action Centre for Urban Development) in Lima, Peru. Luz Maria holds degrees in Architecture, Urban Planning, and Urbanism from Universidad Nacional Federico Villarreal in Lima and from KTH at the University of Stockholm in Sweden, as well as a Post Graduate Degree in International Construction Management from the University of Lund in Sweden. In 2001, she received the Lewis Mumford Award from Architects, Designers, and Planners for Social Responsibility (ADPSR) for the programs implemented in Lima on behalf of Estrategia. UN-HABITAT has also nominated various Estrategia programs as "Best Practices." Luz Maria is an active partner of GHI. Since 1990, with the pilot experience of a neighborhood in Lima, Estrategia has carried out successful urban upgrading and renewal programs in Lima's poorest neighborhoods. Luz Maria has coordinated the formation and training of women's groups, who produce seismic and resistant building supplies out of alternative concrete, construct houses with prefabricated components and

start their own microenterprises to commercialize these building materials. These are considered model projects, based on participation and organization of the local population as well as a clear gender focus. For the GEM Project, Luz Maria served as the local partner for Lima and assisted Verónica Cedillos with conducting interviews and distributing surveys.

Padang, Indonesia

Mona Yolanda received a B.S. in Political Science from Andalas University in 2006. She has over three years' experience in earthquake and tsunami preparedness in the West Sumatra area of Indonesia and was a former Project Manager for the tsunami alert organization, KOGAMI. She has worked for several international non-governmental organizations and agencies such as the United Nations Development Programme, the Japan International Cooperation Agency, Caritas Switzerland, and Mercy Corps. Most of her work has focused on disaster risk reduction (DRR) education and building earthquake resistant housing. She is currently working as a freelance consultant for programs and agencies working on DRR activities. For the GEM Project, Mona served as the local partner for Padang and assisted Verónica Cedillos with translation, conducting interviews, and distributing surveys.

San Francisco, USA

The project team did not work with a local partner in San Francisco. The team made this decision based upon the proximity of GHI's Palo Alto office to the city and the number of contacts that GHI staff already had with earthquake experts and disaster risk reduction professionals in the area. Justin Moresco consulted a number of professional contacts and coordinated all of the San Francisco interviews. Lori Peek conducted the interviews with Justin in San Francisco.

Thimphu, Bhutan

Tenzin Choden is a program officer with the Department of Disaster Management under the Ministry of Home and Cultural Affairs in Thimphu, Bhutan. She has worked in the Department for the past five years. In this position, she manages projects and coordinates with government and international organizations on disaster preparedness and response activities. Tenzin has a Bachelor's degree in Arts from Sherubtse College in Kanglung, Bhutan and she is currently pursuing a Master's in Public Policy at the Australian National University in Canberra, Australia. For the GEM Project, Tenzin served as the local partner for Thimphu and assisted Hari Kumar with conducting interviews and distributing surveys.

Karma Tshering is the GeoHazards International (GHI) National Coordinator for Bhutan. In this role, she leads all GHI projects in Bhutan. Prior to joining GHI, Karma held a number of senior positions within the Ministry of Home and Cultural Affairs of the Royal Government of Bhutan, where she served for 15 years. She holds a Master's degree in Rural Development Management (Khon Kaen University, Thailand) and a

Bachelor's degree in Political Science (Delhi University, India). She facilitated the interviews in Thimphu for the GHI-CSU project team.

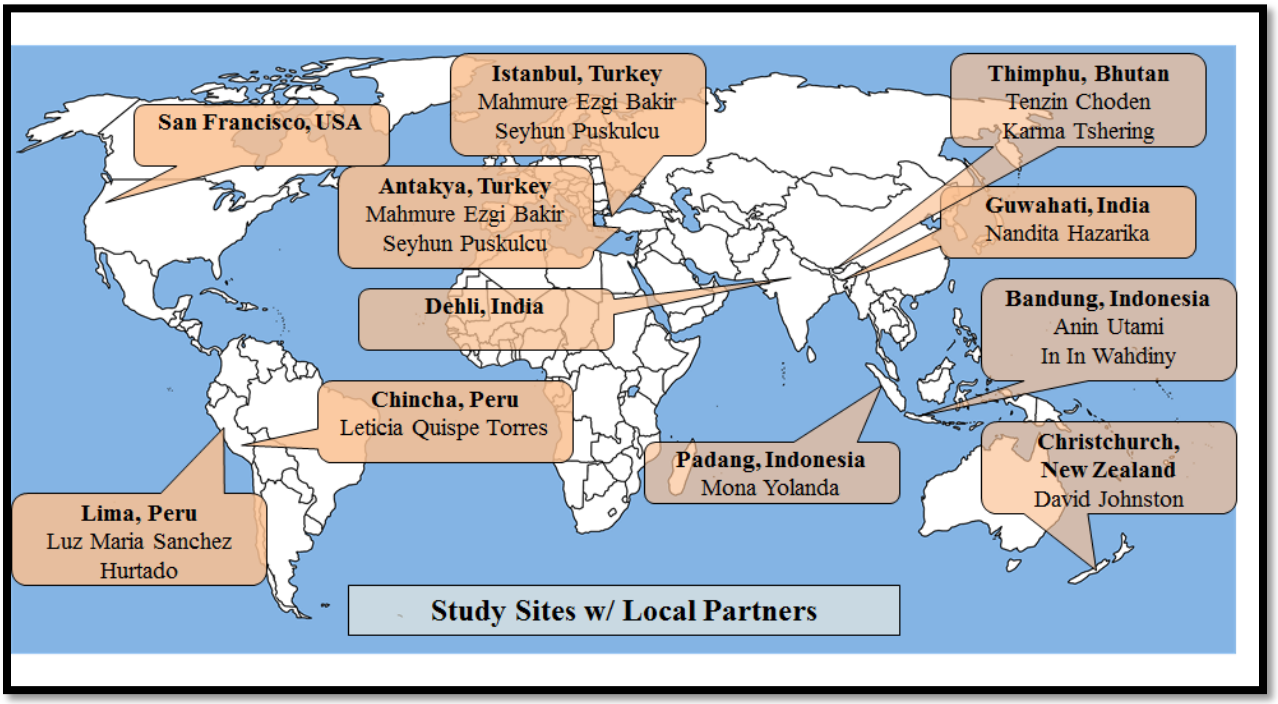

Figure G.1. Study Site Map with Local Partners Highlighted

Appendix H – Local Partner Contact Information

Local Partner Name and Email	Title and Affiliation	City, Country
M. Ezgi Bakir ezgi.bakir@boun.edu.tr	Earthquake Trainer and Master's Student in Geophysics Department, Bogazici University Kandilli Observatory and Earthquake Research Institute	Antakya and Istanbul, Turkey
Seyhun Puskuluc puskul@boun.edu.tr	Seismologist, B.U. Kandilli Observatory	Antakya and Istanbul, Turkey
Anin Utami auindrama@yahoo.co.id anin@ppmb.itb.ac.id	Research Assistant, Research Center for Disaster Mitigation, Institute Technology Bandung (ITB)	Bandung, Indonesia
In In Wahdiny inin_wahdiny@yahoo.com in.in@ppmb.itb.ac.id	Research Assistant, Research Center for Disaster Mitigation, Institute Technology Bandung (ITB)	Bandung, Indonesia
Leticia Quispe Torres leary_11@hotmail.com	Tecnico de Campo (previament) 2008-09, I.T.D.G.	Chincha, Peru
David Johnston D.M.Johnston@massey.ac.nz	Professor Massey University, Director of the Joint Centre for Disaster Research	Christchurch, New Zealand
Nandita Hazarika nandita.hazarika@gmail.com	State Project Officer, Assam State Disaster Management Authority	Guwahati, India
Mona Yolanda andalas_here@yahoo.com	Project Officer, Mercy Corps	Padang, Indonesia
Luz Maria Sanchez Hurtado ongestrategia@gmail.com sanchezmarilu23@yahoo.com	Architect an Urban Planner, Estrategia, Centro de Investigacion y Accion para el Desarrollo Urbano	Lima, Peru
Tenzin Choden tenzey@hotmail.com	Program Officer of the Preparedness and Mitigation Division in the Department of Disaster Management, Ministry of Home and Cultural Affairs	Thimphu, Bhutan
Karma Tshering karmadt@gmail.com	National Coordinator for Bhutan, GeoHazards International	Thimphu, Bhutan

Appendix I – Interview Guide[89]

Thank you for meeting with us today. My name is [XX] and this is [XX]. We are part of a research team supported by the Global Earthquake Model Foundation, an international, collaborative initiative to help calculate and communicate earthquake risk worldwide.

As part of this project, we are traveling to 10 cities in 7 countries to learn about programs and activities that have helped people prepare for and reduce their earthquake risk. We will use this information to advise the Global Earthquake Model Foundation on how they can make their earthquake risk information available, for free, to professionals like you.

We have a series of questions that we would like to ask you. The interview should take about 1 hour [1.5 hours with translation] to complete. Is it okay if I record it, so I can focus on you rather than trying to take extensive notes? The recording will not be shared with anyone outside of our research team.

Do you have any questions about the interview or the project before we begin?

[Note: give interviewee your business card when you first meet]

Interview Questions:	**Probes:**
1. **Work** First, will you please say your name, title, and the name of your organization? Will you tell me about your job here?	
*2. **Programs – Understanding, Preparing for, and Mitigating Earthquake Risk** What earthquake education, preparedness, or mitigation activities is your organization involved in? [Note: If the interviewee talks more generally about "all hazards" programs, probe to see if they are doing anything earthquake specific. If they offer nothing that is earthquake specific—which is a finding in and of itself—ask the interviewee to respond to these probes in relation to the other hazards program(s) they offer.]	What sparked the creation of these programs? What information and resources do you draw on to implement these programs? What groups do you try to reach with your programs? Why do you work with these particular groups? What tools or strategies do you use to communicate with the people you serve? What strategy is most useful in terms of reaching the largest number of people?
*3. **Barriers** What barriers have emerged with designing or implementing your earthquake [hazards] program?	Have you changed anything about your program itself or your overall strategy to try to address these barriers?

[89] Indonesian, Spanish, and Turkish language versions of the interview guide available upon request.

4. **Partnerships** What lessons have you learned from other leading individuals or organizations about understanding or reducing earthquake risk?	One of the Global Earthquake Model's goals is to reach as wide of an audience as possible with their technical information. If they were trying to share their information in this city, *who* would you recommend they contact?
*5. **Earthquake Risk** When you think about the possibility of a major earthquake happening in your community, what concerns you the most?	Are the people you serve concerned about earthquake risk? Are there other threats or hazards that the public is more aware of and/or concerned about?

During this last part of the interview, we are going to give you a short survey that asks about earthquake risk reduction information. This should only take a few minutes to complete, and then we will talk about your responses.

Interviewee Completes Survey [keep recorder on unless the interviewee seems to be taking an unusually long time and isn't speaking]

After the interviewee has completed the survey, and if time allows, review the survey document with the individual. Ask these follow-up questions as you look at table 1 at the top of page 1:

1. Of those items that you do not have access to, which would be most helpful/useful to you?
2. Of those items that you do have, how do you like the information delivered (maps, charts, on-line, etc.)?
    a. What makes you trust the information that you use?
    b. Do you feel like the information you have already is reliable? Is there anything that you would change to make it more robust or useable?
3. If the Global Earthquake Model Foundation wanted to connect with professionals like you to share their information for free, how would you recommend they do that? What channels should the Foundation use to reach professionals like you?
4. The Global Earthquake Model Foundation wants to help people reduce earthquake risk by developing online tools and resources. What online tools or resources would you like GEM to develop to make you more effective at reducing earthquake risk?

This has been exceptionally helpful, and we are grateful for your time. Are there any final thoughts or comments that you would like to add?

Ask interviewee to complete demographic form.

Interviewee Completes Demographic Form [turn off recorder]

Give interviewee the handout on GEM at the end of the interview.

Appendix J – Survey Questionnaire[90]

Global Earthquake Model Foundation Survey

Think about the organization where you work and the community and people it serves. Which of the following do you already have or would you like to have to help understand earthquake risk? (Note: If you already have access to a resource listed below but would still like the Global Earthquake Model to provide it, please check the 'would like to have' box.)	already have	would like to have	do not need
Projected ground shaking intensity in an earthquake.	❑	❑	❑
Maps of earthquake fault lines in your community.	❑	❑	❑
Maps of potential earthquake-induced landslides or tsunamis in your community.	❑	❑	❑
Projected number of deaths in an earthquake.	❑	❑	❑
Projected number of injuries in an earthquake.	❑	❑	❑
Projected impacts on different population groups (such as elderly, homeless, etc.).	❑	❑	❑
Projected damage to housing in an earthquake.	❑	❑	❑
Projected damage to schools in an earthquake.	❑	❑	❑
Projected damage to businesses in an earthquake.	❑	❑	❑
Projected damage to hospitals in an earthquake.	❑	❑	❑
Projected damage to roads, bridges, and other infrastructure in an earthquake.	❑	❑	❑
Projected damage to electricity, gas, and water delivery systems in an earthquake.	❑	❑	❑
Projected damage to mobile phone networks in an earthquake.	❑	❑	❑
Project damage to Internet networks in an earthquake.	❑	❑	❑
Projected economic losses in an earthquake.	❑	❑	❑
Information about how individuals and families can prepare for earthquakes.	❑	❑	❑
Information about how organizations can prepare for earthquakes.	❑	❑	❑
Information about how to fasten contents of buildings to not fall during earthquakes.	❑	❑	❑
Information about how to strengthen buildings to not collapse during earthquakes.	❑	❑	❑
Access to technical experts who can identify and explain earthquake risk.	❑	❑	❑
Access to technical experts who can help individuals or organizations prepare for earthquakes.	❑	❑	❑

[90] Indonesian, Spanish, and Turkish language versions of the survey questionnaire available upon request.

Which of the following minor or major barriers to implementing earthquake risk reduction activities does the organization where you work experience?	minor barrier	major barrier	not a barrier
Lack of money.	❑	❑	❑
Lack of time to dedicate to such activities.	❑	❑	❑
Too few people available to work on such activities.	❑	❑	❑
Lack of technical expertise.	❑	❑	❑
Lack of earthquake information.	❑	❑	❑
Other, more urgent, social or economic problems.	❑	❑	❑
Other, more serious, hazards.	❑	❑	❑
Lack of interest in earthquake hazards among your colleagues.	❑	❑	❑
Lack of interest in earthquake hazards among the people you serve.	❑	❑	❑

Think about how you receive and share information <u>for professional purposes</u>. How useful have the following information sources been for you over the past year?	low	medium	high	not available	available, but not useful
Newspapers	❑	❑	❑	❑	❑
Radio	❑	❑	❑	❑	❑
Television	❑	❑	❑	❑	❑
Social media (such as Facebook, Twitter)	❑	❑	❑	❑	❑
Scientific publications (such as books, journal articles, trade magazines)	❑	❑	❑	❑	❑
Email	❑	❑	❑	❑	❑
Telephone	❑	❑	❑	❑	❑
Talking in person with community members	❑	❑	❑	❑	❑
Talking in person with scientific experts	❑	❑	❑	❑	❑
General news websites	❑	❑	❑	❑	❑
Government websites	❑	❑	❑	❑	❑
Earthquake- or disaster-focused websites	❑	❑	❑	❑	❑
Earthquake hazard maps	❑	❑	❑	❑	❑

If you were told that the building <u>where you work</u> was going to be damaged in an earthquake, which of the following types of information do you have or would you want?	already have	would like to have	do not need
Projected cost to repair the building after an earthquake.	❑	❑	❑
Projected time (days, weeks, months) that the building would be closed for repairs after an earthquake.	❑	❑	❑
Projected likelihood that the building would collapse, potentially injuring or killing people inside, during an earthquake.	❑	❑	❑
Projected cost to strengthen the building *before* an earthquake in order to make it less likely to be damaged or collapse during a future earthquake.	❑	❑	❑

Name: _____

Appendix K – Demographic Information Form

Name: _____

Title: _____

Organization: _____

Telephone: _____

Email: _____

Gender: ❑ Male ❑ Female

Age: _____

How many years have you lived in this community? _____

How many years have you worked for this organization? _____

How many years have you been involved in earthquake risk reduction activities? _____

We will not share the audio recording of our interview with anyone outside our research team. However, we might want to use your name, title, and organization in the final report. Do you give us permission to use this information in the final report? Yes_____ No_____

Appendix L – Trusted Organizations and Trusted Individuals by City

The tables included below summarize, by target city, the names of the trusted organizations and trusted individuals that respondents identified during the in-depth interviews. Because GEM expressed an interest in potentially reaching out to these organizations and persons, the GHI-CSU team compiled the following 11 city-specific tables, which, taken together, include hundreds of potential contacts.

In some instances, multiple interviewees within the same city named the same trusted organizations or individuals. Thus, the numbers in parentheses following some of the organizations and individuals in the tables indicate a frequency count of the number of participants who identified the same trusted organization or individual. If there is no number in parentheses, then it means that the organization or individual was named by only one participant within a given city.

It is important to note that these tables are not meant to represent comprehensive lists of all of the organizations and individuals working in the area of earthquake risk reduction. Rather, this is a compilation of all of the organizations and individuals that were named during the interviews. The team hopes, however, that the lists will be useful to GEM and provide a starting point for the important work that the foundation continues to do.

Antakya, Turkey

Trusted Organizations	Trusted Individuals
• AKUT Search and Rescue Association • Antakya Hospital • Antakya Provincial Education Directorate • Antakya Health Directorate • Antakya Municipality (4) • Antakya Disaster Coordination Center • Chamber of Civil Engineers • Chamber of Geological Engineers • Disaster and Emergency Directorate Department • Disaster and Emergency Management Presidency (DEMP), Turkish Prime Ministry • Hatay Chamber of Geological Engineering • Hatay Province Health Directorate • Hatay Province National Education Directorate • Istanbul Technical University • Kandilli Observatory and Earthquake Research Institute (KOERI) (7) • Middle East Technical University (METU) (3) • Ministry of Health (2) • Ministry of Interior, Saudi Arabia • Ministry of Public Works and Settlements (3) • Mustafa Kemal University (MKU) (3) • Ministry of Transportation • National Education Directorate • North Atlantic Treaty Organization (NATO) • Orthodox Church • Samandağ National Education Directorate • Sigma Engineering and Laboratory • The Scientific and Technological Research Council of Turkey (TUBITAK) • Turkish Catastrophe Insurance Pool (TCIP) • Governorship of Antakya (2) • Governorship of Hatay • Governorship of Hatay Province Disaster and Emergency Preparedness Directorate (AFAD) • World Bank	• Mehmet Alkan, Civil Defense • Murat Alkaya, Assistant Director, Hatay Chamber of Geological Engineers • Isameddin Cecke, Geophysical Engineer, Antakya Municipality • Ömer Dinçer, Minister of Education (2) • Mustafa Erdik, Director, Kandilli Observatory and Earthquake Research Institute (KOERI) (2) • Nihat Ergün, Minister of Science, Industry and Trade • Ismet Güngör, Turkish Catastrophe Insurance Pool (TCIP) • Gunney, Professor, Middle East Technical University (METU) • Selim Harbiyeli, Co-Director, Chamber of Civil Engineering • Ali Hoca, Member of Chamber of Civil Engineers • Zeki Hüzmeli, Samandağ National Education Directorate • Ahmet Mete Işikara, Ex-Director of Kandilli Observatory • İbrahim Kafadar, National Education Directorate • Mustafa Kesef, Supervisor, National Education Department • Bestami Misirli, Civil Engineer • Joseph Naseh, Restoration Architect and Archeologist, former Director of Orthodox Church • Semir Orsash, Professor, Kemal University • Alaattin Öztürk, M.D., Antakya Hospital • Engin Sözer, Geological Engineer, Antakya Municipality • Hakan Uslu, Sigma Engineering and Laboratory • Mustafa Halil Yüculen, Director, Hatay Province Disaster and Emergency Preparedness Directorate

Bandung, Indonesia (continues on next page)

Trusted Organizations	Trusted Individuals
• Agency for Disaster Management (BPBD West Java Province) • Asian Disaster Preparedness Center (ADPC) • Association of Civil Engineering and Geology Engineering • Australian Government Overseas Aid Program (AusAID) • Bandung City Health Office • Bandung Institute of Technology (ITB) (6) • Board of Forestry and Environmental Watchdog Tatar Sunda (DPLKTS) • Center for Disaster Mitigation, Bahasa (CDM ITB) • Child Fund International • Consortium for Disaster Education (CDE) • Education Agency • Gadjah Mada University (UGM) • Gapensi, Indonesian Entrepreneur Association • Hanshin Department Store, Japan • Hasan Sadikin Hospital • Humanitarian Forum Indonesia (HFI) • Islamic Development Bank (IDB) • Indonesian Institute of Science (LIPI) • Indonesian Chamber of Commerce and Industry (KADIN Indonesia) (2) • Indonesian Meteorological, Climatological and Geophysical Agency (BMKG) • Indonesian Red Cross • Indonesian Society of Critical Care • Indonesia University of Education (UPI) • Indonesian Urban Disaster Mitigation Project (IUDMP) (2) • Information and Communication Agency • International Association of Earthquake Engineering (IAEE) • International Network on Displacement and Resettlement (INDR) • International Organization for Migration (IOM) • Jabar Peduli (2) • Johanniter, German NGO • Kyoto University • Ministry of Health • Ministry of National Education (2) • Ministry of Public Works (2) • Mohammad Hoesin Hospital • Motor Club • National Agency for Disaster Management (BNPB) (3) • National Search and Rescue Agency • National Tropical Outdoor Training Center • New Zealand Government • Oxfam International	• Ahmad Heryawan, Governor of West Java • Dadang Iradi, Education Agency • Andar Manik, General Coordinator, Jabar Peduli • Faizal M. Mohideen, Contractor, PT Erad Multi Selaras/CV Jabar Karya Utama • Krishna Suryanto Pribadi, Civil Engineering Program, Research Center for Disaster Mitigation of the Bandung Institute of Technology (RCDM-ITB) • Kamalia Purbani, Expert Staff for H. Dada Rosada, Mayor of Bandung (2) • Ahyani Raksanagara, M.D., Bandung City Health Office • Sardjimi, School Principal • Udjwalaprana Sigit, Head of Local Agency for Disaster Management (BPBD West Java Province) • Yanti Sriyulianti, Family Care Education Society (Perkumpulan Kerlip (Keluarga Peduli Pendidikan) • Surono, Head of the Indonesian Centre for Volcanology and Geological Hazard Mitigation (PVMBG) • Gatot Tjahjono, Indonesian Chamber of Commerce and Industry (KADIN Indonesia) • Tri Wahyu, M.D., Hasan Sadikin Hospital

• Plan International • Red Cross • Research Center for Disaster Mitigation of the Bandung Institute of Technology (RCDM – ITB) (2) • Scouts Military Program • Unilever • United Nations Centre for Regional • Development (UNCRD) • United Nations Educational, Scientific and Cultural Organization (UNESCO) (2) • United Nations International Decade for Natural Disaster Reduction (IDNDR) RADIUS Initiative (2) • University for Social Welfare (STKS) • World Seismic Safety Initiative (WSSI)	

Chincha, Peru

Trusted Organizations	Trusted Individuals
• Association of Emerging Countries in Solidarity (ASPEN) (4) • Association of Municipalities of the People Affected by the Earthquake (AMUPAT) • Association of National Centers (ANC) • Armed Forces • Catholic University of Peru (2) • Center of Emergency Operations of the San José Hospital (COE) • Chamber of Commerce of Chincha • Civil Defense (6) • Complex Integrated System for Health Education (EDUSAN) and Disease Prevention • COPI, Italian NGO • Executive Unit of Education • Executive Unit of Health • French Development Institute • French Institute of Andean Studies (IFEA) • Geophysics Institute of Peru (IGP) (2) • G&Z Electrical Engineering • Housing Ministry (2) • Intermediate Technology Development Group (ITDG) • International Corporation • Italian Corporation • Local Education Management Units (UGEL), Chincha (2) • Meteorological Institute • Ministry of Education • Municipality of Chincha (3) • National Defense • National University of Engineering (UNI) (2) • National Institute of Civil Defense (INDECI) (3) • National Institute of Statistics and Computing (INEL) • Pan American Health Organization (PAHO) • Peruvian Association of International Cooperation (APCI) • Regional Health Directorate (DIRESA) • Roofs and Homes, Peruvian Governmental Programs • The Navy • Vaso de Leche (Glass of Milk) Program (2)	• Carmen Rosa Calle Abad, Architect, Municipality; Technical Secretariat, Civil Defense • Nora Tasayco Amoretti, Our Lady of Guadalpe High School • Juan José Espinoza Anyarín, M.D., Center of Emergency Operations of the San José Hospital (COE) • Marcela Piedad Goyoneche Ballumbrosio, Education Institution 22756, San Rejis • Juan Alberto Ventura Casas, Mayor of Tambor de Mora, Chincha Province, Department of Ica • Aldo César Bonifacio Castilla • Mariella del Carmen Talla Condezo, M.D., G.M., Health Center of Tambor de Mora • Antonio Huamán • Julio Kuroiwa, Author of Disaster Reduction: Living in Harmony with Nature • Cesar Lula • Andrés A. Rojas Matias, Our Lady of Guadalpe High School • Lucio Juárez Ochoa, Provincial Mayor of Chincha • Juan Ramón Torres Padilla, EPS Semapach, S.A. • Marcela Huasasquiche, Civil Defense, Municipality of Chincha • Teofilo Rolando Palma Quiroz, Former Logistics Specialist of the International Corporation, Current Logistics Specialist with the Italian Corporation • Hernan Tabera, President, Geophysical Institute of Peru • Julián Vilca, Italia Pacifico • Lilian Zamora**,** Association of Emerging Countries in Solidarity(ASPEN)

Christchurch, New Zealand (continues on next page)

Trusted Organizations	Trusted Individuals
• Asia-Pacific Economic Cooperation (APEC) • Bucken Group, Design Company • Canterbury Communities' Earthquake Recovery Network (CanCERN) • Canterbury District Health Board • Canterbury Earthquake Recovery Authority (CERA) (6) • Canterbury Primary Response Group (CPRG) • Canterbury Quake Live, website (2) • Centre for Disaster Research, Massey University, Wellington • Chamber of Commerce (2) • Charity Hospital • Christchurch City Council (4) • Christchurch Gets Ready, website • Civil Defense Department (5) • Council for Social Welfare (CPC) • Crown Research Institute for Geological and Nuclear Science (GNS) • Department of Building and Housing • Department of Education • District Health Board • Earthquake Commission, National Insurance Company • Earthquake Response Team • Environment Canterbury (ECan), Canterbury Regional Council (3) • Economic Development Agency • GeoHazards International (GHI) • GeoNet, Website run by National Institute of Water and Atmosphere (NIWA) (2) • Health Pathways, website • Institute of Professional Engineers of New Zealand (IPENZ) • Lee's Construction • Local Emergency Group • Ministry of Health • Ministry of Social Development (MSD) • National Atmospheric Ground Research Institute (NAGRI) • National Health Coordination Centre (NHCC) • Neighborhood Support, Canterbury • Occupational Safety and Health (OSH) • Orion Power Company • Pegasus Health • Police Department • Recovery Canterbury, Canterbury Economic Development Corp. • Red Cross • Restart the Heart Project • Saint John Hospital • Sports Canterbury	• Skip Berkel, Professor of Emergency Medicine, Hawaii • Roger Bridge, Restart the Heart Trustee • Gerry Brownlee, Canterbury Earthquake Recovery Minister (4) • Richard Burt, Restart the Heart Lawyer • Kim Burgess, Canterbury Primary Response Group • Phil Driver • Bill English, Deputy Prime Minister, Finance Minister, Christchurch • Steve Glassey, Centre for Disaster Research, Massey University, Wellington • Tim Glasson, Restart the Heart Trustee • Helen Grant, Hazards Analyst, Environment Canterbury (ECan), Canterbury Regional Council (2) • Andrew Hampton, Deputy Secretary, Chair of Earthquake Response Team • Chris Hawker, Facilities and Operational Services, University of Canterbury • Sam Johnson, Student Volunteer Army • Mark Keaton, Geologist • Marnie Kent, Sumner Disaster Response Group • Peter Kingsbury, Principal Advisor, Natural Resources, Christchurch City Council (2) • Paul Lonsdale, Restart the Heart Manager, Central City Business Association • Tom McBrearty, Chairman, Canterbury Communities' Earthquake Recovery Network (CanCERN) • Graeme McColl, New Zealand Ministry of Health • Paul McCormick, Former Leader of Canterbury Primary Response Group (CPRG) • Bob Parker, Mayor • Jenny Ridgen, Program Manager, Healthy Environment, Christchurch City Council • Kelly Robertson, Canterbury Primary Response Group • Murray Sinclair, Civil Defense-Emergency Management, Christchurch City Council (2) • John Suckling, Restart the Heart Chairman • Roger Sutton, Chief Executive, Canterbury Earthquake Recovery Authority (CERA)

• Student Volunteer Army • Sumner Disaster Response Group • Tertiary Education Facilities Management Association (TEFMA) • Transit New Zealand • U.S. Federal Emergency Management Agency (FEMA) • University of Canterbury • Victoria University in Wellington	• Steven Tubbs, Restart the Heart Trustee • Sue Vallance, Lincoln University • Sue Wells, Regulatory and Planning Committee, Christchurch City Council • Dave Wilkinson, Neighborhood Support, Canterbury • James Young, Sumner Disaster Response Group

Delhi, India

Trusted Organizations	Trusted Individuals
• All India Institute of Medical Science (AIIMS) • Central Public Works Department (CPWD) • Council of Architecture (CoA) • DAV Public School • Delhi Disaster Management Authority (DDMA) (4) • Department for International Development (DFID) • Earthquakes and Megacities Initiative (EMI) • Federation of Indian Chambers of Commerce and Industry (FICCI) • GeoHazards International (GHI) (5) • India Gandhi Open University • Institute of Interior Designers • Ludlow Castle School • Ministry of Agriculture • Ministry of Environment and Forest • Ministry of Health • Ministry of Home Affairs (2) • Municipal Cooperation of Delhi (MCD) • National Disaster Management Authority (NDMA) (9) • National Institute of Disaster Management (NIDM) (2) • National Institute of Health and Family Welfare (NIHFW) • National Society for Earthquake Technology in Nepal (NSET) • SEEDS India (3) • State Institute of Rural Development • TARU, Consulting Firm • National Disaster Management Authority • National Institute of Disaster Management • United Nations Development Programme (UNDP) (2) • United Nations Children's Fund (UNICEF) • U.S. Federal Emergency Management Agency (FEMA) (2) • U.S. Geological Survey (USGS) • World Bank	• Ian Davis, Managing Director, Oxford Centre for Disaster Studies • Anup Karanth, TARU • B.K. Sharma, Principal, Ludlow Castle School

Istanbul, Turkey

Trusted Organizations	Trusted Individuals
• AfetTR: Google Group Networking Group (2) • Aksigorta • American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) • Center for Disaster Management (CENDIM), Boğaziçi University • Chamber of Mechanical Engineers, Union of Chambers of Turkish Engineers and Architects (UCTEA) • Department of Earthquake Risk Management and Urban Development • Disaster Healthcare Services • Disaster and Emergency Management Presidency (DEMP),Turkish Prime Ministry • Earthquake and Megacity Initiative (EMI) • Foreign Ministry of Turkey • Governorship of Istanbul • Governor of Istanbul National Medical Search and Rescue Team (UMKE) • Governorship of Istanbul Provisional Disaster and Emergency Directorate • Ground and Soil Research Directorate • International Code Council (ICC) • International Search and Rescue Advisory Group (INSARAG) (2), United Nation Office for the Coordination of Humanitarian Affairs (OCHA) • Istanbul Beşiktaş Tuberculosis Defense Center • Istanbul Chamber of Commerce • Istanbul Disaster and Risk Management Directorate • Istanbul Metropolitan Municipality, The Disaster Management Centre of Istanbul City (AKOM) • Istanbul Project Coordination Department (IPCU) • Istanbul Provincial Disaster and Preparedness Department • Istanbul Technical University (ITU) • Japan International Cooperation Agency (JICA) • Kandilli Observatory and Earthquake Research Institute (KOERI) (6) • Middle East Technical University (METU) • Ministry of Finance • Ministry of Health (2) • National Fire Protection Association (NFPA) • Ministry of Construction • Prime Ministry of Turkey • Regional Food Distribution Agency (RFDA) • Swiss Academy for Development • Turkish Society of HVAC and Sanitary Engineers (TTMD) • ULUS YAPI • Underwriters Laboratories (UL) • United Nations (UN) (2) • U.S. Federal Emergency Management Agency (FEMA) • U.S. Geological Survey (USGS) (2) • United States Agency for International Development (USAID) • Urban Search and Rescue Team (USAR) • Vodaphone Foundation • World Bank	• Mahmut Bas, Director, Department of Earthquake Risk Management and Urban Development • Gökay Atilla Bostan, Co-Department Chief, İstanbul Provincial Disaster and Emergency Directorate • Mustafa Elvan Cantekin, Director, Neighborhood Disaster Volunteers (MAG) • Necmi Ercin, Co-Department Chief, Istanbul Provincial Disaster and Preparedness Department • Mustafa Erdik, Director, Kandilli Observatory and Earthquake Research Institute (KOERI) • Türkay Esin, M.D., Disaster Healthcare Services • Eren Kalafat, President, ULUS YAPI • Hüseyin Nail Kavlakoğlu, M.D., Istanbul Beşiktaş Tuberculosis Defense Center • Osman Kilic, Deputy Director, Istanbul Metropolitan Municipality Directorate of Earthquake and Ground Analysis • Ali Nasuh Mahruki, President, Search and Rescue Association (AKUT) • William Mitchell, Professor, Baylor University • Marla Petal, Co-Director at Risk RED • Seyhun Puskulcu, Bogazici University KOERI Disaster Preparedness Unit • Kadir Topbaş, Mayor of Istanbul Metropolitan Municipality

Lima, Peru (continues on next page)

Trusted Organizations	Trusted Individuals
• Andean Committee for Disaster Prevention and Relief (CAPRADE) • CAF Government Institute • Civil Service Office • Commission on the Environment • COFOPRI, Agency to Formalize Property • Control Center of Emergencies and Disasters • EDELNOR, Public Service Company Electricity • Disaster Congressional Commission (2) • Environmental Committee • Equality Program, Social Services • European Commission • European Union (2) • Federation of the Women of Ica • Geophysics Institute of Peru (IGP) (4) • Health Commission • Housing Ministry (2) • Hyogo Framework for Action • Integrated Development Institute (IDI) • Lima Chamber of Commerce • Local Education Management Units (UGEL) • Management of Marine Hydrology • Ministry of Communications and Transportation • Ministry of Conservation • Ministry of Education (3) • National Fishing Society (SNP) • Ministry of Health (3) • Mexican Petroleum (PEMEX) • National Institute of Civil Defense (INDECI) (11) • National Institute of Culture (INC) • National Institute of Statistics and Data Processing (INEI) • National Ministry of Education (MINEEDU) • National Risk Management System (CINEGEL) • National Society of Industries (SNI) • National Society of Mining, Petroleum, and Energy • National Service for Construction Industry Training (SENCICO) • National University of Engineering (UNI) • Navy • Neighborhood Services • Occupational Safety and Health Administration (OSHA) International • Office of Community and Environmental Education, Ministry of Education • Office of Energy • Office of Environmental Health • Office of General Services and Maintenance • Office of Infrastructure, Ministry • Office of National Defense • Oxfam International	• Marino Costa Bauer, Former Peruvian Health Minister (1996-1998) • Dante Chumpitaz • Carlos Alberto Malpica Coronado, Ministry of Health • Mauricia Pantoja Bello, Nurse, Office of General Services and Maintenance • Katianna Elizabeth D. Baldéon Caqui, Ministry of Health • Red Yul Sánchez Cárdenas, Integrated Development Institute (IDI) • Esperanza Moreno Carrera, Professor, Environmental Committee • Cecilia Rosell Grijalba, National Society of Industries (SNI) • Carmen Rosa Suárez Herrera, Risk Management Council • F. Imamura, Peruvian-Japanese Center of Seismic Research and Disaster Mitigation (CISMID) • Hans Berger Jeepeta, Corporative Management Relations, Electro South of Peru • Maraví Miller Joaquin, Sub-General Manager, Civil Service Office • S. Koshimura, Peruvian-Japanese Center of Seismic Research and Disaster Mitigation (CISMID) • Julio Kuroiwa, Author of Disaster Reduction: Living in Harmony with Nature • Juan Alberto Borjas Lengua • Castorina Villegas López, Groots Peru • Pedro Ferradas Mannucci, Program Manager for Disaster Prevention and Local Governance, Practical Solutions • Miguel Estrada Mendoza, Peruvian-Japanese Center of Seismic Research and Disaster Mitigation (CISMID), National University of Engineering (UNI) • Jorge Luis Chumpitaz Panta, Ministry of Education • Susana María del Carmen Villarán de la Puente, Mayor • Mario Wilfredo Palomino Rivera, Integrated Development Institute (IDI) • Juan Manuel Tomasevich Rodriguez, Rimac Civil Defense Municipality • Hernando Tavera, Geophysics Institute of Peru (IGP) (3)

• Pan American Health Organization (OPS) (2) • PNUD Development Program, United Nations • Peruvian Association of Insurance Companies (APESEG) • Peruvian Chamber of Construction (CAPECO) • Peruvian Exporter's Association (Adex) • Peruvian and Japanese Center of Seismic Research and Disaster Mitigation (CISMID), National University of Engineering (UNI) (2) • Peruvian Safety Enterprises Association • PERUCAMARAS, National Council of Commerce, Production and Services for Investments • Peru Geophysical Institute (IGP) • Planification Institute • Public Ministry • Red Cross • Rimac Civil Defense Municipality • Risk Management Council • Risk Management Network, website • Save the Children • SECRENET, Phone Company • SEDAPAL, Public/Private Water Supplier (2) • Solidarity with the Third World (SOTERMUN), Spanish NGO • Southern Reconstruction Fund (FORSUR) • United Nations (2) • United Nations Children's Fund (UNICEF) (2) • United Nations Educational, Scientific and Cultural Organization (UNESCO) (3) • University of El Callao • University of Texas (UT) • Urban Development Institute (CENCA) (2) • Vaso de Leche (Glass of Milk), Social Program • World Bank	• Andrea Tang Valdez, National Society of Industries (SNI) • José Vargas Via, Manager, Urban Development • Julio Quijano Villaorduña, Ministry of Health • Augusto Miyashiro Yamashiro, Mayor of Chorillos District • Carlos Alberto Zavala, Zavala, Peruvian-Japanese Center of Seismic Research and Disaster Mitigation (CISMID), National University of Engineering (UNI)

Padang, Indonesia

Trusted Organizations	Trusted Individuals
• Asian Disaster Preparedness Center (ADPC) • Asian Disaster Reduction and Response Network (ADRRN) • Cement Padang • Disaster Management Agency (BPBD), Sub-National Level (7) • Disaster Risk Reduction (DRR) Forum, West Sumatra • Disaster Risk Reduction (DRR) Scout Tagana(2) • Fire Department (2) • Health Department, West Sumatra Province • Health Department System for Disaster (SPGTAMS) • Indonesian Boy Scout, GerakanPramuka • Indonesian Meteorological, Climatological, and Geophysical Agency (BMKG) • Indonesian Red Cross • Jemari Sakato • Kelompok Kerja Guru (KKG), Teacher Working Group • Komunitas Siaga Tsunami (KOGAMI) (3) • KSBS, Student Group (3) • Mercy Corps (2) • Ministry of Communication and Information (Depkominfo) (3) • Muhammadiyah and Asyiyah, Religious Organization • National Agency for Disaster Management (BNPB), Padang City • National Health Department, Padang (2) • Provincial Planning Department (BAPEDA) • Public Works Department (3) • Red Cross • Search and Rescue Team • Telkom Indonesia • United Nations Educational, Scientific, and Cultural Organization (UNESCO)	• Andy Arif, Disaster Expert, Presidential • Syafrimet Azis, Executive Director, Jemari Sakato • Afrida Aziz, Head of Department of Health, Padang • Ade Erfina, Teacher, Disaster Risk Reduction, Senior High School • Ahmad Firdaus, Safety Environment Chief, PT Sement Padang • Tut wuri Handayani, National Health Department, Padang City • Henky Maygesz, Head of Rehabilitation Section, Disaster Management Agency (BPBD) • Elivia Murni, Teacher, SDN 28 • Nuwirman, Jemari Sakato • PatraRinaDewi, Executive Director, KomunitasSiaga Tsunami (KOGAMI) • Ramanera, Head Master, SMU Pertiwi 1 Padang Senior High School • Imran Sarimudanas, Jemari Sakato • Syaiful Syanin, M.D., Prof M. Djamil Hospital, Central Hospital of West Sumatera Hospital • SetiaWelly, Telkom Indonesia • Yudi Aningsekar Widayanto, Vice Head Master, Supervisor for Disaster Risk, Senior High School • Asnul ZA, ChiptaKarer, Public Works Department

San Francisco, USA (continues on next page)

Trusted Organizations	Trusted Individuals
• Agency for Healthcare Research and Quality (AHRQ) • Allied Schools Program • American Red Cross (6) • Applied Technology Council (ATC) • ASCD (formerly the Association for Supervision and Curriculum Development) • Association of Bay Area Governments (ABAG) (4) • Association of Continuity Planners (ACP) • AT&T • Bay Area Coordinated Assistance Network (CAN), Online Database • Bayview Opera House • California Conference of Local Health Officers (CCLHO) • California Emergency Management Agency (CalEMA) (3) • California Emergency Medical Services Authority • California Geological Survey (CGS) • California MyHazards, website • California Volunteers, State Agency • Center for Disease Control (CDC) • Chevron • Churches Helping Churches • CitizenVoice.org • Community Action Plan for Seismic Safety (CAPSS) • Department of Building Inspection • Consortium of Universities for Research in Earthquake Engineering (CUREE) • Department of Building Inspection (3) • Department of Emergency Management (6) • Department of Homeland Security • Department of Public Health (2) • Department Operational Center (DOC) • Degenkolb Engineers • Disability Disaster Preparedness Committee (DDPC) • Disaster Council, City of San Francisco • Earthquake Country Alliance • Emergency Preparedness Office (EPO), California Department of Public Health (2) • Ferrell Civil Engineering • Fritz Institute, Bay Area Disaster Preparedness (2) • Genentech Incorporated • Geological Association • Get Ready Program, Neighborhood Empowerment Network • Harvard School of Public Health • Hazards U.S. Multi-Hazard (HAZUS-MH) • Health San Francisco • Hitachi • Humboldt State • Incident Command System (ICS) • Institute for Healthcare Improvement (IHI) • International Association of Emergency Management (IAEM)	• Brad Aagard, U.S. Geological Survey (USGS) • Alessa Adamo, Executive Director, SF CARD (2) • Tomas Aragon, Health Officer, Department of Public Health, City of San Francisco • David Bonnewitz • Lloyd Cluff, Pacific Gas and Electric (PG&E) • Kelly Cobean, Engineer, Consortium of Universities for Research in Earthquake Engineering (CUREE) • Malia Cohen, District Supervisor • Ontario Smith, PG&E • Dan Dworkin, Director, Safety and Technology, The Hamlin School • Lucas Eckroad, School Liaison, Department of Emergency Management (2) • Rich Eisner, Fritz Institute, Bay Area Disaster Preparedness • Kent Ferre, Director, Geosciences Department, Pacific Gas & Electric (PG&E) • Joanna Fraguli, Mayor's Disability Council, Disability Disaster Preparedness Committee (DDPC) • Tom Frieden, Center for Disease Control (CDC) • G.L. Hodge, Administrator, Providence Baptist Church of San Francisco • Bill Holmes, Structural Engineer, Former CAPSS Consultant • Daniel Homsey, Neighborhood Empowerment Network • Carla Johnson, Disaster Planning Coordinator, Mayor's Office on Disability • Laurie Johnson, Fritz Institute, Bay Area Disaster Preparedness (2) • Anna Marie Jones, CARD, East Bay • Bijan Karimi, Department of Emergency Management • Laurence Kornfield, Project Manager, Community Action Plan for Seismic Safety (CAPSS) • Ed Lee, Mayor

• Joint Commission • Kaiser San Francisco • Laguna Honda Hospital and Rehabilitation Center • Lifelines Council • Lutheran Disaster Services • Mayor's Office of Neighborhood Services (MONS) • Mayor's Office on Disability (MOD) • Mother Brown's Dining Room • National Emergency Management Association (NEMA) (2) • National Incident Management System (NIMS) (2) • National Oceanic and Atmospheric Administration (NOAA) (2) • Neighborhood Emergency Response Teams (NERT) (4) • Neighborhood Empowerment Network • Office of Emergency Management, Planning Department, Mayor's Office • Pacific Gas and Electric (PG&E) (4) • Providence Baptist Church of San Francisco • Public Advisory Committee • Public Health Association • Public Health Foundation (PHF) • Ready.gov (4) • ReallyReady.gov, website by Federation of American Scientists • Rutherford & Chekene (R&C) Engineering Firm • Salvation Army • San Francisco Apartment Owners Association • San Francisco Coalition for Neighborhoods • San Francisco Community Agencies Responding to Disaster (SF Card) (2) • San Francisco Fire Department (2) • San Francisco Fire Prevention Safety Society • San Francisco Foundation (2) • San Francisco Interfaith Council • San Francisco Planning and Urban Research Association (SPUR) • San Francisco Police Department • San Francisco Unified • Simpson Gumpertz and Heger (SGH) Engineering Firm • Small Business Administration • Standardized Emergency Management System (SEMS) (2) • Swiss Re, Fireman's Fund • University of California, San Francisco (UCSF) • U.S. Federal Emergency Management Agency (FEMA) (5) • U.S. Geological Survey (USGS) (4) • United Way • Verizon • Volunteer Organizations Active in Disaster (VOAD) • Walter & Elise Haas Fund • YMCA • 72hours.org, website, City of San Francisco (5)	• Leonard J. Marcus, Co-Director, National Preparedness Leadership Initiative (NPLI); Joint Program of the Harvard School of Public Health (HSPH) and the John F. Kennedy School of Government • Susan Mizner, Director, Mayor's Office on Disability (MOD) • Gavin Newsome, Former Mayor • Walter Patrick, Director of Emergency Planning and Preparedness, San Francisco Unified School District • Jeanie Perkins, Association of Bay Area Governments (ABAG) • Chris Poland, CEO, Degenkolb • Susan Pritchison, Department of Energy Management • Amy Ramirez, Department of Emergency Management • Laura Samant, Consultant, Community Action Plan for Seismic Safety (CAPSS) • Heidi Sieck, Government General Services Agencies • Greg Smith, American Red Cross • Brian Whitlow, SF CARD • Zan Turner, Department of Building Inspection (DBI) • Lann Wilder, Emergency Management Coordinator • Stasha Wyskiel, Manager, GAP Business Continuity Planning

Thimphu, Bhutan

Trusted Organizations	Trusted Individuals
• Asian Disaster Preparedness Center (ADPC) (3) • BHU Hospital • Bhutan Broadcasting Service (BBS) (2) • Bhutan Power Corporation • Bhutan Standard Bureau • Bhutan Telecomm • Chamber of Commerce • Department of Culture (2) • Department of Disaster Management (DDM) (9) • Department of Forests • Department of Geology and Mines (DGM) (2) • Department of Health • Department of Medical Services • Department of Roads • Department of Urban Development Services • Department of Youth and Sports • Disaster Reduction Unit, UNDP-BCPR • Disaster Management, Ministry • Focal Disaster Management • GeoHazards International • Help Center SSC • Human Works and Settlements • ISEB • Ministry of Economic Affairs • Ministry of Education (4) • Ministry of Health (3) • Ministry of Home and Cultural Affairs (2) • Ministry of Works and Human Settlements (2) • Municipal Office • National Disaster Management Authority (NDMA) • Pacific Emergency Disaster Management Plan (PEDM) • Police Department • Renew • Royal Society for Protection of Nature (RSPN) • RST Transport Group • Save the Children International (2) • SBCA, Cultural Conservation • SPCA • Strategic Operation for Health Care Emergencies (SSOHCED) • Tarayana Foundation • Thimphu Valley Earthquake Risk Management Project (SQCA) • United Nations Children's Fund (UNICEF) (4) • United Nations Development Programme (UNDP) (2) • United Nations International Strategy for Disaster Reduction (UNISDR) • United Nations Environment and Disaster Management Team (UNEDMT) • United National Habitat • World Health Organization (WHO)	• Gorab, Search and Rescue • Melinda Smith, United Nations Children's Fund (UNICEF) • Sonam, Safe Schools Initiative


GeoHazards International
Working Toward Global Earthquake Safety


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University