Dissemination of information on hazards and risks: the Icelandic experience

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SUMMARY:
This paper deals with on-going activities related to the Task Group H activities on "Disaster prevention strategies based on an education information system", carried out within the project framework of UPStrat-MAFA "Urban prevention strategies using macro-seismic and fault sources". The emphasis is on the Icelandic experience and related work. Civil Defence/Civil Protection in Iceland has distributed information to the public about disasters since the seventies, first about nuclear war and later about natural disasters. For the last decade the Earthquake Engineering Research Centre of the University of Iceland has used these materials, along with their own material and technical capacity, to educate school children, aged 10 to 12, and provided information for local exhibitions. This article presents an overview of these efforts and the factors guiding the development of information packages to the public, school staff and children, along with a discussion of the challenges and success of these efforts.

Keywords: Disasters, education, information material, UPStrat-MAFA, earthquakes

1. INTRODUCTION

Iceland is an active volcanic island with high seismicity situated in the North Atlantic Ocean. The present-day seismo-tectonic activity is primarily related to the Mid-Atlantic Ridge that crosses the country with a strike slip configuration in the NE and SE regions (Sigbjörnsson et al., 2007). The largest historic earthquakes in Iceland have occurred within these zones and have exceeded magnitude 7. Major earthquake sequences in the SE region have affected the sparsely populated farmlands through historical times with recurrence intervals ranging from 45 to 112 years (Sólnes et al., 2004). Now, approximately 25,000 people live in the area. The most significant earthquakes in Iceland in recent decades have been in the SE region, on the 17th and 21st of June, 2000, with moment magnitudes of 6.5 and 6.4, respectively, and an earthquake on May 29th, 2008 of M_w 6.3 (Sigbjörnsson et al., 2009). The earthquake on June 17th 2000 had a significant duration of 8 seconds; the one on June 21st 2000 lasted only 5 seconds (Sigbjörnsson et al., 2009), and the more recent May 2008 earthquake lasted only about 4 seconds in the near source zone. Numerous moderate earthquakes of up to M 6 have also shaken the population in South Iceland. Educating people on the seismicity of the area they live in and the risks associated with possible future earthquakes was placed under the mandate of National Civil Defence in Iceland (NCDI), now Civil Protection (CP), in 1967. From the beginning the NCDI has emphasised disseminating information about earthquakes and other natural hazards in order to increase and maintain public awareness. Other institutions have also undertaken the dissemination of information on hazards and risks and educating the population. This paper discusses some of the efforts taken by NCDI/CP and the Earthquake Engineering Research Centre of the University of Iceland regarding natural hazards in general or specific to earthquakes.

2. NATIONAL TELEPHONE DIRECTORY

Various countries use the phonebook as a medium to convey messages to the public. After its establishment NDCI was soon allotted pages in the phonebook to inform people what to do before, during and after a disaster. Initially, the information was about first aid and what to do in case of a nuclear war, but was later updated to information about natural disasters. The number of pages allotted decreased through the years from 8 to 4, however, 2 pages in English and 2 pages in French were later added although the French pages have recently been switched to Polish. The respective embassies provided the translation. The information pertains to volcanic eruptions, lightening, violent storms, storm surge, landslides, avalanches and earthquakes as they are the key hazards in Iceland although lightening occurs infrequently. In the late nineties the text was rewritten, and more importantly, reformatted. First of all, the format changes involved colour coding the text to assist people to quickly find what they were looking for, make the pages more attractive and easier to remember. Black is general information, such as risk information, about the system and headings, pre-event information for mitigation purposes is green and red is what to do during or after a disaster has occurred (see Figure 1, Símaskráin, 2011).

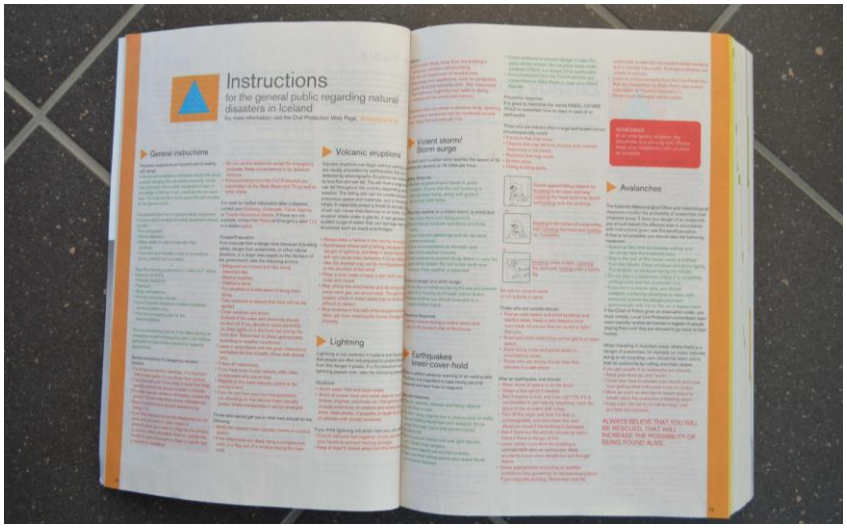

Figure 1. Instructions for the general public are printed in the Icelandic telephone directory (Símaskráin, 2011). Different coloured text, depending on the type of information being conveyed (general, before and during/after a disaster) and orange edges to make the pages easier to find.

Additional changes included a map with the frequencies of national radio stations (both AM and FM) in the different regions around the country, while the relevant frequency for each region was also added on the title page of each region in the phonebook. Despite these pages being listed in the table of contents on the first page of the phonebook, the NCDI had received complaints from people having difficulty finding these information pages, for example, when feeling stressed after an earthquake. This need was addressed by marking the edge of the pages of the phonebook with an orange band, making the pages easy to find. Finally, pictures of the well-known duck-cover-hold sequence during an earthquake were added. The phonebook is published once a year and is free to those wanting to pick up one or as many as they want. The information is now also available on the Internet (www.almannavarnir.is).

3. HOME AND FAMILY

The NCDI embarked on a special campaign for earthquake awareness in 1975 in the aftermath of a series of earthquakes in Borgarfjördur in West Iceland; at that time the information in the phonebook had not been updated to natural disasters. An 8-page, size A5, pamphlet was distributed to all earthquake-prone areas in Iceland. The pamphlet described ways people get hurt during an earthquake, a few factors on predicting earthquakes, ways to mitigate earthquake risk, how to behave during an earthquake and what to do afterwards.

In an attempt to catch the attention of the younger generation, the NCDI developed caricatures that young people could relate to. A professional designer was brought in for the task who suggested a young male character; however, the NCDI wanted both a male and female character. They were named Alvar (the boy) and Alvör (the girl), which are acronyms derived from the word civil defence in Icelandic (**Al**manna**var**nir and **Al**manna**vör**n). Their clothes are in the colours of civil defence: orange and blue. Alvar and Alvör are used to depict pictures of the duck-cover-hold sequence, which have been used in a colouring book (see Figure 2).

Figure 2. The caricatures Alvör and Alvar (left), (www.almannavarnir.is, 2000) and the duck-cover-hold sequence (right) depicted in a colouring book for children (Almannavarnir, 2004).

Mitigation and preparedness activities done by homemakers (who are often also homeowners) greatly affect the amount of damage sustained by residential buildings and their content, and therefore also impact the response level required by authorities, volunteers and neighbours. In 2001, the NCDI created an easy step-by-step guide for homemakers in the form of a web-based Home Plan (see Figure 3, www.almannavarnir.is). The text is in Icelandic but can be converted to English using translation options available on the Internet. The plan is in four parts; risk assessment, mitigation, a response plan, and then exercises for people to test, refresh their memory of and review their plan. One of the motivating factors discussed in the introduction of the plan is concern for loved ones during a disaster. In today's world the family is often in different places during the day – work, school, home, friends, gym, club, etc. – and are not likely to be together when an earthquake strikes during a normal working day. The idea was that a family, including the extended family, for instance, grandparents not living in the home and siblings who have moved away from home, would come together to discuss as a group what could happen in their community and their home, and what they could do about it. The idea of helping thy neighbour during or after a disaster is an important message conveyed in the guide. The phonebook was (and still is) thought to provide a source of information that people can use to help

identify risks and be a basis for discussion. Alvar and Alvör could be used to catch the attention of the younger kids.

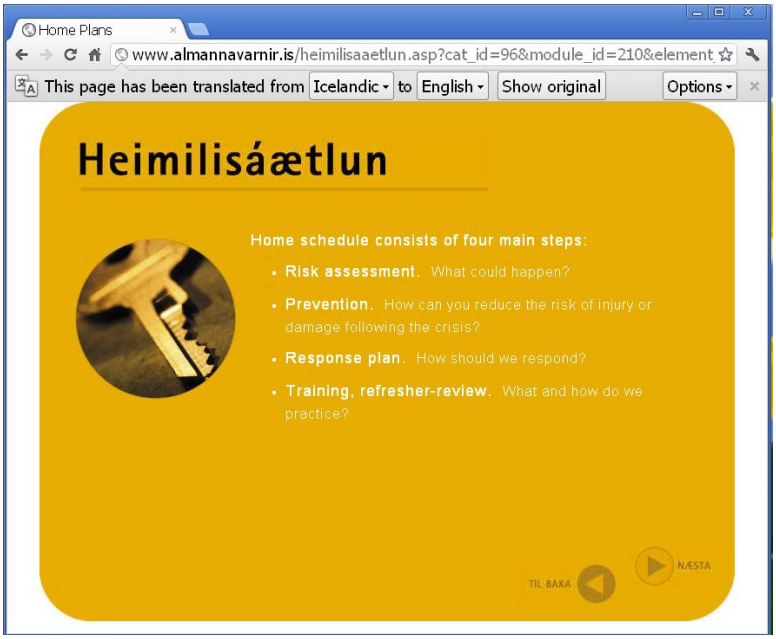

Figure 3. Home Plan for homemakers (www.almannavarnir.is, 2012)

The Chief of Police in Rangarvallasýsla County contacted the EERC when nearly 100 years had passed since the great destructive South Iceland Earthquake in 1896. This led to the SEISMIS project (Sigbjörnsson and Ragnarsdóttir, 1999), a project aiming specifically at raising earthquake awareness as well as preparing for and mitigating earthquakes. The key part of the project was seismic risk assessment and vulnerability analysis of residential buildings to identify weak spots and lead to practical advice on mitigating measures.

The risk assessment was carried out using a scientifically defined sample reflecting, building types, building material, building locations and ages of buildings. Early on it became clear that the main earthquake threat to people was primarily related to building content, loose objects and inventory rather than structural failure or collapse of buildings. Therefore, a door-to-door survey was carried out in the most vulnerable areas to inspect and assess the potential threat from the building inventory, including falling and toppling objects, damage due to failure of piping systems, etc. Each family received a written statement consisting of (i) general advice regarding preparedness, and (ii) specific advice suggesting changes or modifications regarding the building structure, its interior and inventory. Finally, a follow-up survey was conducted after a certain time had passed, to inspect whether or not the families had followed the advice. It turned out that most families had indeed followed it or gave a good reason why they had not done so. As part of this initiative, a special earthquake issue of the local newspaper, *Sunnlenska*, was published and distributed to each household in the South Iceland Lowland. This special issue contained articles on the earthquake history of the area, geological and geophysical background, what might happen during earthquakes; furthermore, there was advice on how to prepare for the earthquake threat, how to behave during an earthquake, and what to do after a major earthquake (Sigbjörnsson and Ragnarsdóttir, 1999; Akason, Olafsson and Sigbjörnsson, 2006a; 2006b).

The anticipated earthquake struck in 2000 after the above-mentioned project was finished. A large survey was carried out after the earthquake using the mentioned pre-earthquake sample, among others,. Apparently, it was the overall view of the population in South Iceland Lowland that the above-mentioned initiative had reduced expected damage and prevented accidents (Sigbjörnsson and Ragnarsdóttir, 2008).

4. EARTHQUAKE BOOKLET FOR SCHOOL STAFF

In the late nineties, the NCDI attempted to provide educational information to The National Centre for Educational Materials to be used by school teachers to raise the awareness of schoolchildren on topics related to natural disasters and what they and their families can to do reduce their risk and prepare to respond appropriately. These efforts were not successful as there were many groups lobbying for new material to be placed on the school curriculum; the competition was tough. As an alternative, the NCDI and The National Centre for Educational Materials produced a booklet on earthquakes directed at school staff and teachers at the kindergarten and primary school level on how to mitigate earthquake risk, how to behave during an earthquake, and how to work with children after an earthquake has occurred. The booklet encourages exercises, interaction with the parents and checklists prepared by the staff and teachers on what needs to be done to make the school earthquake-resistant and to prepare for response efforts in case the school is damaged or collapses during an earthquake. Other comforts include compiling lists of important phone numbers and getting acquainted with local first responders. Information regarding the various activities is provided on the left side and space to write up a checklist is provided on the right side. Again, colour coding was used in order to help the readers differentiate between the different parts: the first chapter on mitigation was green (see Figure 4); the second on response was red, and the recovery section was blue. Part of materials for earthquake readiness in schools in United States, in particular from California and Federal Emergency Management Agency, was used in developing the material.

The booklet was sent to all schools in Iceland. The introductory remarks suggested that school staff go over their lists at the beginning of every school year.

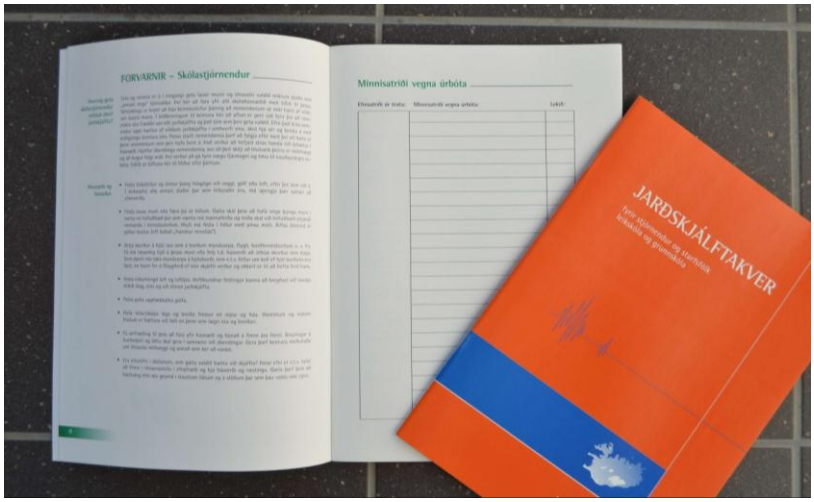

Figure 4. An earthquake booklet for teachers in kindergartens and primary schools, published by The National Centre for Educational Materials and NCDI (Jardskjálftakver, 1999).

5. RAISING SCHOOL CHILDREN'S EARTHQUAKE AWARENESS

The Earthquake Engineering Research Centre (EERC) of the University of Iceland was established in the spring of 2000 in the town of Arborg, situated in the South Iceland seismic zone. Prior to the move, the earthquake engineering research facility was a located in Reykjavik at the main campus of the University of Iceland. The Centre offers awareness training free of charge for school children, aged 10 to 12, and has done so since 2001. This initiative came out of a request from school teachers in Reykjavik to bring a class for a visit to the Centre and learn about what it does. In total, 2370 pupils and 241 teachers have participated in the training, ranging from 10 to 30 boys and girls at a time. The training takes one and a half hours and starts with an introduction of the EERC. It then moves on to tell the children about earthquakes that have occurred in the past, both in Iceland and in other countries. The training material includes material from the NCDI, such as photos of Alvar and Alvör and chosen pages from the Earthquake Booklet. A video from the 1989 Loma Prieta earthquake in California has been used as staff members from the Centre went to California after the earthquake and can relate personal stories to the children. Photos from the earthquakes in 2000 and from the 2008 earthquake add a sense of reality to the training, especially for children from outside the affected area. A video showing a simulation from a full-scale shake table also provides realistic images for the children. The photos include earthquake faults, buildings before the earthquake and after they were damaged by the earthquake, fallen and broken building contents, including pictures taken in children's bedrooms. Through these different media the facilitator tries to bring home the seriousness of earthquakes, while at the same time trying to avoid frightening the children. The children are taught where and how earthquakes happen, both in Iceland and abroad, and are introduced to the Icelandic Strong Motion Network run by the EERC. They are shown into the computer lab from which the sensors are controlled. The facilitator brings out an oscilloscope and asks the children to hop and observe how the vibration of the floor is detected by the devices. The children participate in two others exercises. In the first one they are asked to make a checklist for their home and school, based on the principles in the booklet. In the second they practice duck-cover-hold, where the instructor measures how long it takes for all the pupils to find a safe place. This exercise is repeated. In every case the children are quicker finding safe places in the second exercise, giving them a sense of learning and confidence.

Figure 5. The facilitator asks the children to hop and watch how they "create" an earthquake. Photo taken at the Earthquake Engineering Research Centre by Símon Ólafsson.

The visit ends with ice-cream in the Centre's cafeteria. The teacher(s) accompanying the children are given a copy of the booklet and are encouraged to apply the guidelines in their own schools. After conducting the training a few times by request, the Centre began sending letters of invitation to local schools on a regular basis and offering the training to all interested school.

Figure 6. The children practice duck-cover-hold twice during the training. Photo taken at the Earthquake Engineering Research Centre by Jón Börkur Árnason.

6. EARTHQUAKE EXHIBITIONS

The EERC has supported local efforts to raise earthquake awareness by providing expertise and technical assistance. Two examples are mentioned here. First, the Árnesingar Folk Museum in South Iceland on May 29th 2008, named The House at Eyrarbakki, collected stories, memories, photos, film-clips and personal items (mostly damaged items) from locals who had experienced the 2008 South-Iceland earthquakes and held an exhibition during the summer of 2009 season under the name "Where were you – the big earthquake" (Annual Report of Byggdasafn Árnesinga 2009, 2010). Information from the Centre helped to place these stories into context with the seismicity in the area.

The EERC has also cooperated closely with the village of Hveragerdi, located 12 km west of the Centre. During an excavation for a new shopping centre in 2004, the contractors uncovered a surface fault running right through the building site; the building permit was subsequently lowered from a 3-storey to a single-storey building. It was decided to clean up the fault and cover it with a transparent floor to allow people so see it (although a mat had to be placed on the floor as some people refused to walk over the transparent floor). The EERC provided the South Iceland Tourist Information Centre, located in the shopping centre, with a poster describing seismicity in the area as part of an earthquake information campaign.

The EERC manages the Icelandic Strong-Motion Network, established in the mid-eighties. It provides nation-wide coverage of the most important seismic zones (Sigbjörnsson 2004). In 2007, the Centre established a small-aperture strong-motion array in Hveragerdi, the ICEARRAY network, to record significant earthquakes in the region, establish quantitative estimates of the spatial variability of their strong ground motion, and shed light on earthquake source processes (Halldórsson et al., 2009). Of the eleven monitors, the EERC placed one on either side of the fault that are visible to those who peer

down into the fault. The network measured Peak Ground Accelerations in Hveragerdi ranging from 51% g to 101% g (Halldórsson and Sigbjörnsson, 2009). No catastrophic collapse of structures or physical injuries occurred in Hveragerdi during the event; however, the damage was extensive, (Sigbjörnsson et al., 2009) and many were visibly upset.

In the summer of 2011 the mayor of Hveragerdi initiated a collaborative effort to set up a permanent exhibition on seismicity in the region next to the fault in the village shopping centre. It is about what happened during the 2008 earthquake. The exhibition was thought of as not only an interesting way to convey history but also an opportunity for locals to express themselves, (Hafsteinsdóttir, 2012). In addition to the information already provided by EERC, the Centre provided a power-point show that runs continuously on a TV monitor. The show presents the EERC, The Iceland Strong-Motion and ICEARRAY networks and, in particular, measurements and effects of the 2008 earthquake. The show includes an animation of spatial and temporal motion from aftershocks measured in the months following the May earthquake by the ICEARRAY, enabling viewers to visualize the causative fault of the earthquake that runs past the town at a distance of 1 km. Additional exhibits from other sources include footage from surveillance cameras from various places in Hveragerdi during the earthquake, posters with information about the geological, geophysical and environmental aspects of the area, and earthquake impacts, such as damages, changes in the environment and personal stories. A typical scene from a kitchen after the earthquake, of broken personal items along with artefacts made from objects broken during the earthquake, is displayed.

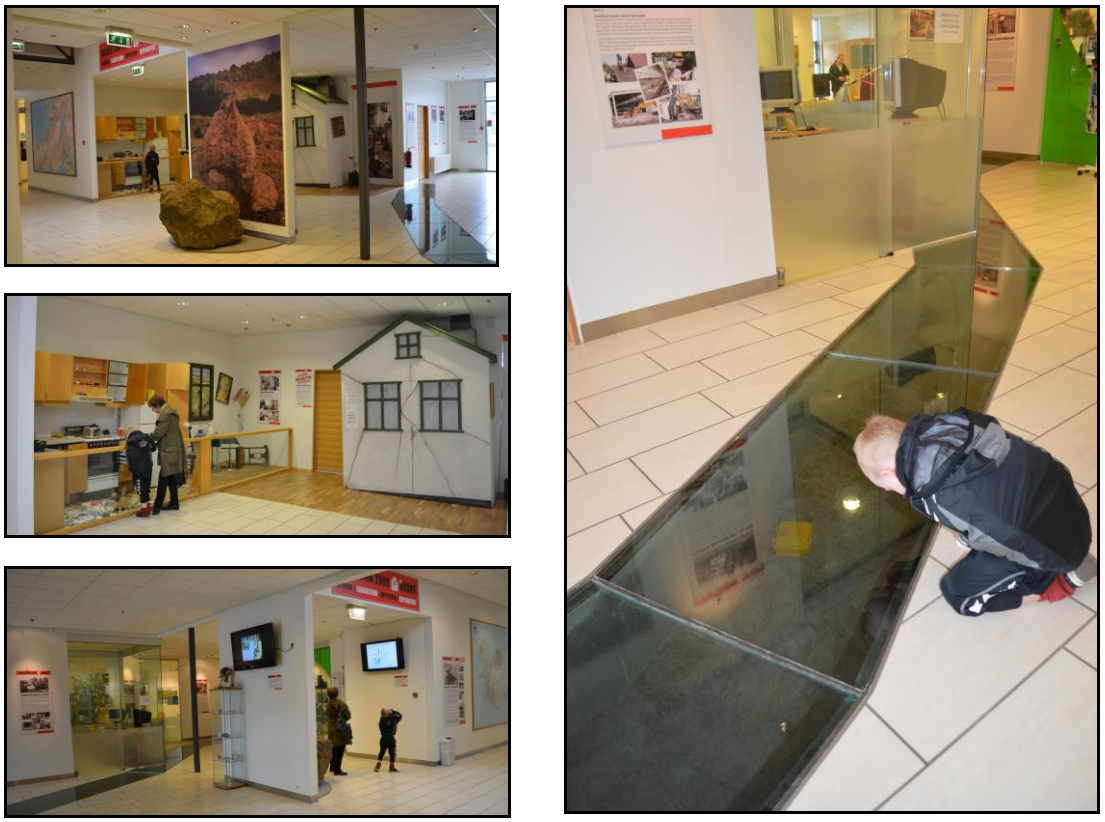

Figure 7: Top left: Entrance to the exhibition. Middle left: Badly damaged kitchen and a house that shakes. Bottom left: Monitor in front has pictures from locals and monitor in back has information from EERC. Stories are on placards on the walls. Broken items are in a glass case. Right: Boy peering into surface fault. The yellow box is an ICEARRAY monitor. Photo: Sólveig Thorvaldsdóttir.

7. DISCUSSION

Organized dissemination of natural hazard and risk information, along with guidelines for mitigation and preparedness measures, started in 1975 in Iceland after a series of non-damaging earthquakes in West Iceland. The earthquakes instigated an earthquake awareness campaign within all earthquake regions in Iceland, which was met with serious resistance as promoting fear. This resistance has gradually waned through the years with increased impact from natural phenomena, including earthquakes, avalanches and volcanic eruptions, (Jónsson, 2012). Today natural risk mitigation and preparedness is generally accepted as part of living on this natural hazard-prone island.

In the seventies, the best way to reach people was through the phonebook. The internet has changed the landscape; people are now more likely to look for information via the internet and less likely to even have a hardcopy of the phonebook at hand. People can therefore, to a much greater extent than before, find information pertaining to earthquakes on their own. Although the Internet is a huge source of information, the simplicity and availability of a hardcopy phonebook with succinct information should not be overlooked; for example, you can still read it when the Internet is down. Since the information is available, the question becomes what is it that motivates people to search for information, spend time reading it to gain knowledge on the topic and most importantly, take action to mitigate earthquake risk and prepare for possible future events.

Placing a natural risk institute, such as the EERC, inside the seismic zone and thus close to – or rather making it part of – the population at risk has enabled the local population to have greater access to specialists in the field. Even people outside the immediate area, such as in Reykjavik, have shown more initiative in seeking information now after the Centre moved from Reykjavik to a higher risk seismic zone, than when it was situated in Reykjavik.

The EERC has been giving sessions to increase children's earthquake risk awareness for over a decade. For the children it instils knowledge, motivates them and creates memories that could instigate further positive activities in the future. The experience of the EERC staff has been positive; the children have been interested, receptive to the information and thoroughly enjoy the exercises. Although no direct tests have been administered, the keen interest shown by the children indicates that are more acutely aware of earthquakes after they leave than before they came to the class. A second factor for the Centre is that it gains visibility; although this not a major factor, it is still an important one. The teachers accompanying the children also benefit as they are taught how to prepare their schools. An indirect effect of these visits may be to motivate some of the children to study science or engineering. The training is short and requires very little preparation and therefore does not take up a lot of the staff's time from the staff It is gratifying for the staff to work with the children, and they always look forward to the visits. In today's world of information, the role of a motivator, such as played by the EERC, is critical.

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