

Seismic risk communication in Europe over the last two decades

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Introduction

Risk communication is a key component of risk management. It can raise risk awareness, increase preparedness and promote the adoption of protective measures before, during and after disaster events. To enable risk reduction and resilience, risk communication should be a two-way, dynamic and interactive process, rather than a one-way transfer of information from experts to citizens.

Since the Seveso Directive I (1982), international guidelines such as the Yokohama Strategy (IDNDR, 1994), the Hyogo Strategy (UNISDR, 2005) and the Sendai Framework (UNISDR, 2015-2030) have recognized the potential of risk communication to promote community empowerment. From the Yokohama Strategy to the Sendai Framework, communication approaches have evolved from the prevailing one-way model to more comprehensive transdisciplinary strategies that envision working directly with communities at risk to motivate them to take precautionary action. The Sendai Framework promotes communication approaches that are tailored to the needs and capacities of different groups and communities. It emphasizes the importance of a whole-of-society approach to risk communication that involves all stakeholders, including governments, civil society, the private sector, academia, the media and communities. Effective communication requires different strategies for each disaster phase: mitigation, preparedness, response and recovery. An analysis of risk communication strategies can be found in the mid-term review of the implementation of the Sendai Framework (United Nations Official Documents, 2023). Nevertheless, an in-depth analysis of earthquake risk communication practices is still a research gap. This study aims to fill this gap by focusing on seismic risk communication and its development in Europe.

Methodology and analysis

We applied the scoping review method (see Musacchio et al., 2023 and reference therein) and structured our analysis around the following questions: “What are the main characteristics of earthquake risk communication practises and research in Europe?” and “Have they changed over time?”. To answer these questions, we analysed selected publications from three scholar databases, i.e., Scopus, Web of Science and Google Scholar, to obtain the most comprehensive overview of scientific publications.

Before beginning our analysis, we examined how the literature on seismic risk communication has evolved over time, starting in 1970. The Google Scholar database shows that the number of

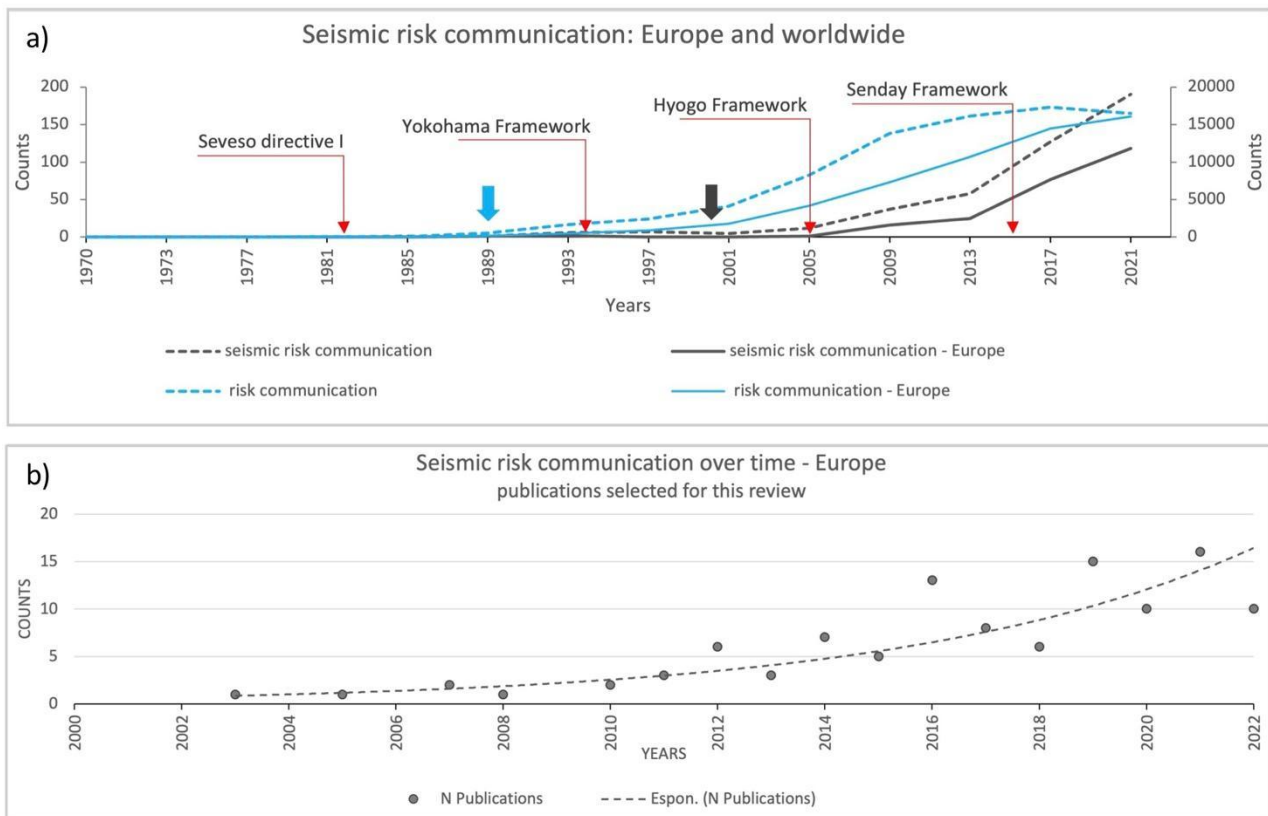


Fig. 1 – a) Publications on seismic risk communication over time. Raw data from Google Scholar database searches according to the strings listed in the text are plotted for all risks (right y-axis) and seismic risk communication (left y-axis) in Europe and worldwide; b) publications shortlisted for this review study.

publications increased significantly after the year 2000 (Fig. 1a), whereas it was negligible before. Therefore, we filtered out publications with the following terms in the period 2000-2022 (Fig. 1b): seismic risk communication; earthquake risk communication; seismic risk education; earthquake risk communication; educational seismology; seismic risk education campaign(s); seismic risk awareness campaigns. Other criteria included peer-reviewed full-text publications in English and case studies from European countries. Some additional documents were found via citations in the selected publications.

We shortlisted 482 documents that underwent further screening after reading the title, abstract or main text to remove duplicates, grey literature (conference proceedings, abstracts, reports, dissertations, web documents, magazine/newspaper articles), documents not strictly focused on earthquake risk communication or not dealing with case studies in Europe. Finally, 109 publications were considered for the scoping review (see Musacchio et al., 2023 for more details).

The 109 selected publications were examined on the basis of six key aspects of risk communication (Fig. 2), namely when the communication takes place, who communicates what to whom, why and how. We divided the publications among all co-authors in order to be able to read and categorise them in detail.

Results

The interest of the scientific literature in the communication of seismic risks seems to begin shortly after the Hyogo framework (Fig. 1a). The first paper in our selected collection was published in 2003 (Fig. 1b); the analysed publications were mainly published in geoscience journals (45%), risk or disaster journals (18%) and books (17%). The main topics covered are disasters, preparedness, risk perception and social issues, and the most frequently mentioned country is Italy. Following the structure of the key questions described in the previous section (Fig. 2), we summarise the main findings below (more details are reported in Musacchio et al., 2023).

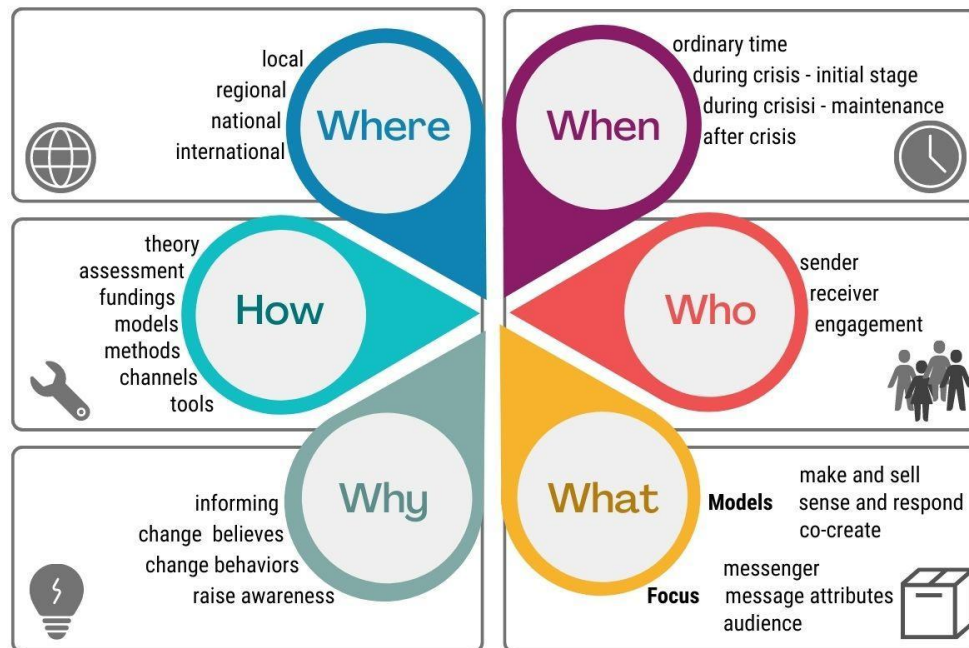


Fig. 2 – Issues under investigation for the screening of the selected publications.

When - The overwhelming majority of the selected documents (75%) dealt with earthquake risk communication in ordinary time (Fig. 3a) i.e., in the pre-event phase of the disaster risk management life cycle.

Who - Research centres and universities are among the main senders/organisers of communication activities (72%). Pupils and students (40%) and citizens (27%) are the main recipients. Recipient engagement is described in about half of the publications (46%). The vast majority use a joint development or implementation model between experts and the public, while only a few publications describe a joint evaluation model.

What - Since 2013, the two-way (43%) communication model (see Stewart et al., 2023 for description of the communication models) has been the most widely used (Fig. 3b). However, the one-way model is still mentioned in a fairly large number of publications (29%). Interestingly, the three-way model (“instruct and co-create”) was adopted by less than 20% of authors, although its prevalence increased over time.

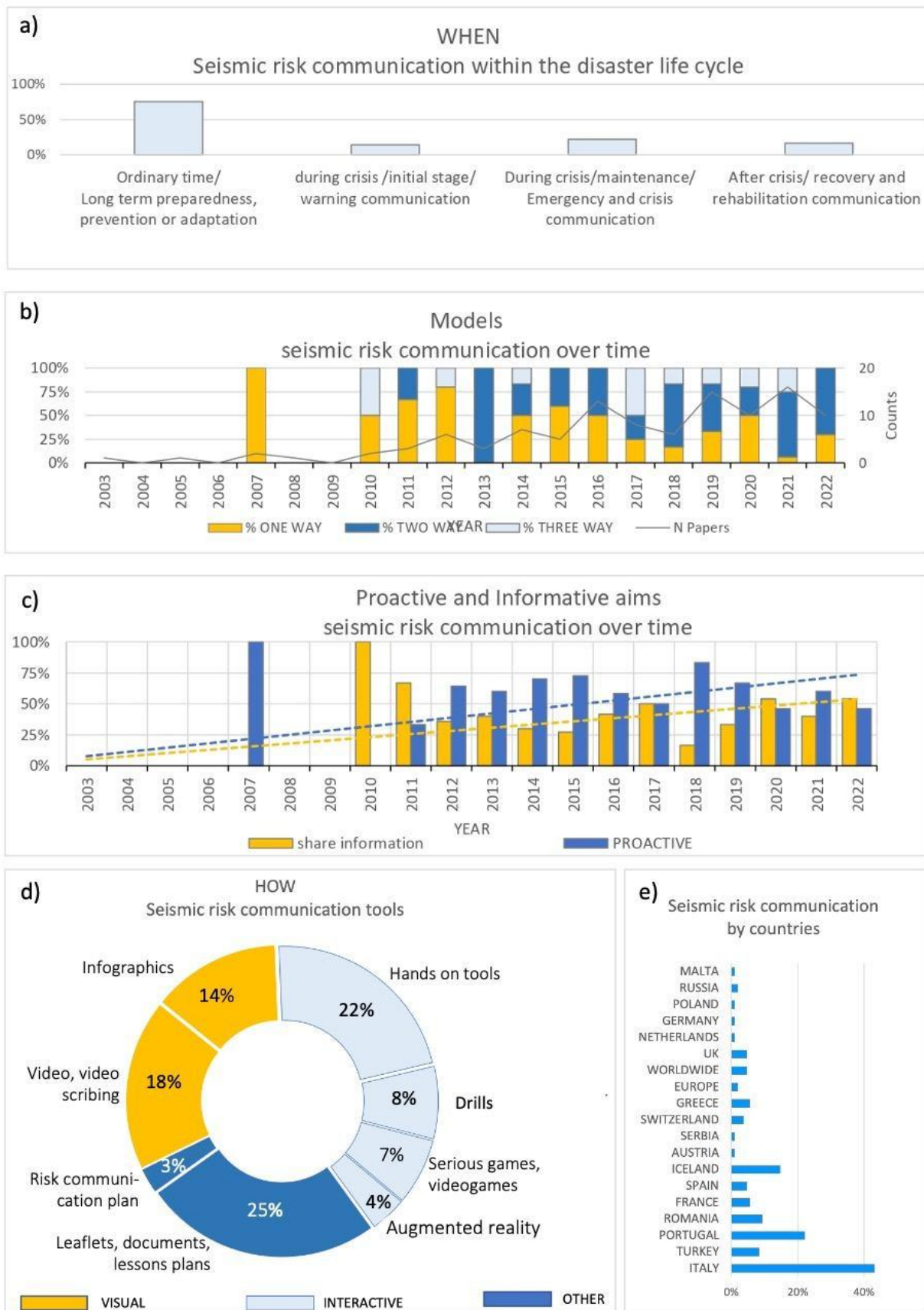


Fig. 3 – a) The selected publications on seismic risk communication within the disaster life cycle; b) the communication models used over time; c) the communication objectives mentioned in the publications; d) the tools used for communication; e) Countries of the case studies reported in the selected publications.

Why - The stated goals of seismic risk communication (multiple responses) are to share information (62%), raise awareness (47%), change behaviours (27%), change beliefs (16%), and increase preparedness (4%). Over time, communication has become more proactive than informative (Fig. 3c).

How - Interactive and visual language tools were mentioned most frequently, regardless of the temporal distribution (Fig. 3d). Serious games and augmented reality have only appeared in our data sample since the beginning of 2016. Personal communication (face-to-face, 39 %) far outperformed the internet (7 %) and even the mass media (4 %). However, the evolution of communication techniques is clearly evident in the use of social media, which enables rapid interpersonal communication and collaboration even during disasters (e.g., Saraò et al., 2023).

The methods used for communication practices were mostly surveys (18%) and classroom activities (16%), while focus groups, outreach events and interviews were the least used. However, multiple methods were reported in 24% of publications.

Risk communication research and practice is mainly funded by public international (29%) and national (26%) institutions. Only about half of the publications report on the evaluation of the efficiency/performance of seismic risk communication. The majority of publications (80%) do not explicitly formulate their theoretical basis. When theories are mentioned, deficit and behavioural models are the most frequently cited.

Where - Seismic risk communication started at the local level with the documentation of practices implemented in different countries and then took on an increasingly international character over the years. Seismic risk communication in Europe is unevenly distributed across countries, with Italy having the highest number of documents in the analysed dataset, followed by Portugal, Iceland, Romania, Turkey, France and Greece (Fig. 3e). This could be related to our criteria for the selection of documents and does not necessarily indicate a lack of interest in seismic risk communication. However, with regard to Italy, we mention two earthquakes that had a strong impact on seismic risk communication in Italy. These are the 2002 earthquake in San Giuliano di Puglia (Mw=5.7), which led to the collapse of a school and the death of 26 children and their teacher, and the 2009 earthquake in L'Aquila (Mw=6.3) and the well-known legal dispute associated with it.

Conclusions

Although earthquakes are a threat in many countries and considerable resources have been invested in safety regulations, communities at risk often lack awareness and preparedness. In this study, we reviewed the literature on earthquake risk communication in Europe published since 2000. We analysed the approaches, messages, tools and channels used for communication and how they have changed over time. The main objectives of seismic risk communication over the last two decades were to share information, raise awareness, change behaviours/beliefs and increase preparedness. Communication has mainly taken place in the pre-crisis phase of a disaster's life cycle, when risk awareness and the ability to cope with hazards can be effectively built. Pupils, students and citizens were the main recipients of the communication activities.

Over the years, two-way, transdisciplinary and bottom-up communication models have prevailed over the one-way model. In addition, communication has increasingly aimed at encouraging proactive behaviour rather than simply informing the public. Face-to-face conversations, hands-on

activities and serious games are the main tools used to engage with the public. The findings also show the growing importance of social media to reach different audiences, provide timely and actionable information in times of crisis and engage citizens. Furthermore, communication about seismic risks is practised in different ways in different countries.

As with any review study, we recognise that the results and their interpretations apply only in the context of the selected scientific literature, which does not include grey literature and documents in languages other than English. Nevertheless, we believe that the main features we have identified provide an interesting overview of the topic and can serve as a reference for future studies. The future agenda for seismic risk communication should focus on building trust with the public, tailoring communication to their needs and moving towards a three-way model of seismic risk communication that engages stakeholders from different sectors - academia, business, government and civil society — for the common goal of earthquake safety and seismic resilience.

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