

Summary description of project context and objectives

General project description and objectives

NERA aims at a measurable improvement and long-term impact in the assessment and reduction of the vulnerability of constructions and citizens in Europe to earthquakes. To accomplish this, NERA will

- a) integrate key research infrastructures monitoring earthquakes and accessing their hazard and risk and,
- b) improve the use of these integrated facilities and their data, by developing multidisciplinary tools and applications in observational and strong-motion seismology, modeling, geotechnical and earthquake engineering.

NERA also provides and promotes access to high quality services providing earthquake data and parameters, hazard and risk products, and research grants for visiting and using specialized seismological and engineering research facilities.

Description of work performed and main results

Project objective first year

The main objective for NERA's first reporting period was to obtain a current state-of-the-art overview of all aspects of the integrated research infrastructure. The obtained result provides the groundwork for our project, ensure a broad coordination beyond the NERA consortium and ensure our targets are up-to-date and that the final project output will be truly transformative.

Work performed

The project complete management and operational structure was set-up within a few months and the planned objective have been accomplished within the first year of the project. The project produced 17 deliverables, 3 additional reports, and (already) 2 publications. At international meetings NERA produced at least 23 presentations and 6 posters. Its strong coordinating role within Europe was clearly displayed in 6 open workshops, often together with other initiatives or projects. Nearly 30 meetings have been taking place to coordinate work within and among WP's. In all, the NERA project obtained a broad overview of relevant state-of-the-art developments and positioned itself as a key coordinator of many on-going related initiatives and projects. Below we illustrate this more specifically in four topics.

European monitoring and data archival Infrastructures

NERA progress on the European monitoring and data archival infrastructure builds on the accomplishments of many national networks and data centers, notably ODC and GFZ, and previous EC-projects like NERIES and European coordinating organizations like ORFEUS and EMSC.

The Virtual European Broadband Seismic Network (VEBSN), a joint data sharing initiative of observatories, has extended its set of open data with 52 additional stations reaching a total of 556 stations in the region. The European Integrated waveform Data Archive (EIDA), an innovative geographically distributed, but interoperable, set of data archives (currently 5 nodes), has implemented significant updates of its technology.

The infrastructure initialized a significant extension by setting up coordination of Ocean Bottom Seismometer (OBS) data centers, structuring European scale mobile deployment policies, planning an European scale acceleration data access, standardizing school seismological network data access and earthquake engineering field testing data. More specifically:

- coordinating data integration with OBS networks and datacenter,
- setting up a long-term strategy to deploy mobile stations across Europe,
- initializing the Alp-Array initiative – a cross Alps integrated monitoring experiment,
- implementing an ambitious plan to provide open access to data from European acceleration networks,
- starting to build a European strong-motion database in collaboration with the SIGMA project.
- developing an implementation and deployment policy that integrates several mobile networks into one European Rapid-response Network (ERN),

- laying the groundwork for an overview of earthquake engineering field testing equipment, stakeholders and methodologies
- compiling an inventory of school seismology networks, and pursue standard data exchange of data within this community.

Improving risk and hazard assessment

NERA progress on the risk and hazard assessment capacities of the research infrastructures builds on previous and on-going projects like SHARE, GEM, SYNER-G, etc. In this first project period the work focused on coordinating and integrating the accomplishments of these projects, thus ensuring we build on past achievements and obtain added value results. More specifically:

- identifying key player in European building inventory data collection,
- summarizing the state-of-the-art knowledge of building inventory data in Europe

Developing tools facilitating data interpretation

Five work packages are addressing specific tools. Four of those started evaluating the state-of-the-art and preparing appropriate data sets for tool testing. review of recent data on surface topography effects and establish a common data format, specifically:

- software toolbox definition and review of existing relevant software
- review on studies related to spatial variability of ground motion in the near field
- assembling a sub-set of near-source earthquake data records

During the start-up phase of the project some concrete results have also been provided; specifically:

- a Bayesian method of evaluating and combining probabilistic earthquake forecasts
- an automatic fault-plane software package HASH
- a software package (SCARDEC) for rapid automatic analysis to obtain Mw, focal mechanism, source time function and focal depth.

Providing access to existing research facilities

NERA includes three service activities providing earthquake information and parameters (EMSC: www.emsc-csem.org), waveform data and products (ORFEUS: www.orfeus-eu.org), and earthquake hazard and risk (EFEHR: <http://appsrvr.share-eu.org:8080/share/>) primarily for the European-Mediterranean area. Two of these services have been actively used by a broad public (EMSC) and mainly scientists (ORFEUS). Summarizing some major achievements:

EMSC:

- belongs to the 25,000 most visited web sites in the world with 4 – 12 Million visits/month,
- provides now also services for mobile phone services uses social networks,
- Introduced an 'innovative 'authoritative locations' scheme, promoting the contribution and expertise of all national networks.

ORFEUS:

- delivered in 2011 > 13 TB of digital data for research to scientists,
- initialized global initiatives standardizing XML and web services for seismological data,
- Improved and added QC products and produced for > 50 stations its meta data.

The EFEHR is currently in a reliability and stability testing phase.

NERA also provides grants to access four seismological and earthquake engineering facilities at KOERI – Istanbul Turkey, NIEP – Bucharest Romania, AMRA – Naples Italy, and NORSAR – Kjeller Norway. This first year 6 grant have been provided, representing 12% of the total planned access over the whole project duration.

Expected final results and potential impacts

NERA will deliver measurable, long-term impact beyond the present state-of-the-art in all steps leading to a correct assessment of seismic risk – in the definition of engineering requirements, in collection of input data, in their analysis, in procedures for hazard assessment, and in engineering applications – as well as long-lasting structural impact in areas of crucial societal and economic relevance. Focusing on the long-term impacts in random order.

A. Integration of key research infrastructures in Europe to monitor, assess and prevent earthquake hazards

NERA will have a profound long-term effect on the infrastructure panorama in Europe, bringing together the main classes of infrastructures covering different aspects of earthquake monitoring and hazard and risk assessment under a single program, as well as expanding the access to and collection of data. On the basis of the NERIES successful implementation, we can confidently expect that the NERA effort will be able to expand the coverage to a wider range of infrastructures beyond the initial set chosen by NERIES, and to bridge between seismology and earthquake engineering.

B. Establishing one key element of the EPOS (European Plate Observing System) RI infrastructure

NERA will contribute with two important elements in EPOS by:

- Constructing a coordinated and broadly oriented seismological observational infrastructure, by integrating a wide diversity of seismological networks and data centers with ORFEUS as coordinating organization.
- Coordinating and implementing a seismological and earthquake engineering data service facility involving a distributed, but integrated, set of data archives, including innovative and standardized service facilities for the research community.

C. Reduction of vulnerability of European citizens and constructions to earthquakes

All the NERA activities are designed to contribute important tassels to the key long-term aim to reduce the vulnerability of European citizens and constructions to earthquakes. NERA will produce the first complete building taxonomy and inventory for buildings of the whole Euro-Med region, will establish the corresponding vulnerabilities with field testing and will implement the collected data in risk assessment. NERA's strategic, wide-geographical coverage will result in the harmonization of the procedures for monitoring and for hazard and risk assessment and ultimately in safer building construction practice in the whole Euro-Mediterranean region.

D. Capacity of civil protection authorities and society to react during an earthquake and in the post-earthquake and recovery period

NERA covers uniformly the critical phases in the earthquake cycle: long-term preparation, event (including short-time event preparation and post-event emergency) and recovery. All these aspects pose important challenges for our society and for the response of the authorities to the earthquake. We recognize that the physical prediction of earthquakes is not a target that can be explicitly pursued in the immediate future and within the restricted implementation period of NERA, and that possibly we will never be able to reach. Nonetheless, the combination of approaches and the selection of near-fault observatories offer the most concrete possibility in Europe to date to initiate a coordinated effort to collect new data and develop new knowledge that in the long-term might enable a better understanding of the physical processes leading to the earthquake initiation.

E. Harmonization of hazard and risk input, output, and assessment methodologies

NERA will build a framework for integration across disciplines, by involving participants, competences and experts spanning all fields from seismology to geotechnical engineering to earthquake engineering, and for integration across national borders, to compile earthquake data and assess seismic hazard and risk without the burden of political constraints and administrative boundaries. Authoritative community models will be assembled, a modern assessment of seismic risk will be made the common European standard, a long-lasting level of harmonization on a European scale instead of only national level. Among the highlights:

- a standardized approach to field installation, data collection, storage and distribution, and quality control will be extended to all the sectors of observational seismology.
- a unified taxonomy and inventory for European building
- overall progress in waveform modeling and parameter extraction by developing codes and applications will find immediate application in all seismological agencies and serve as basis for future projects.

F. European participation in the Global Earthquake Model program initiated by the OECD

Important elements of NERA are integral components of GEM, the most comprehensive program in global risk assessment ever proposed. Specifically:

- The European hazard component of GEM, covered by the SHARE project, will be integrated within the common infrastructure portal.
- The assessment of system vulnerability and associated risk, covered by the SYNER-G project, will be integrated within the common infrastructure portal.
- The first comprehensive classification and inventory of European buildings to be accomplished in NERA, will be in full alignment with the global inventory initiated by GEM in 2010, but will maintain the granularity and specificities appropriate for Europe.
- The NERA-EFEHR Service Activity, will be the European component of the GEM Global Model Facility delivering harmonized assessment of seismic hazard and risk

G. Impact for the long-term integration of the seismological and earthquake engineering communities

The two communities have traditionally been separated in the academic world, but are converging on a common agenda under the increasing pressure from society to bring together the science and engineering knowledge required to mitigate the earthquake risk. NERA is the first project aiming at an integration of both infrastructures in Europe. The societal demand bringing together the seismological and earthquake engineering communities will not decrease in the future and provides the ground for the long-term impact of NERA.

Project web page: www.nera-eu.org