SHARE

SEVENTH FRAMEWORK PROGRAMME

# Grant Agreement no. 226967
# Seismic Hazard Harmonization in Europe
# Project Acronym: SHARE

**SP 1-Cooperation**

**Collaborative project: Small or medium-scale focused research project**

**THEME 6: Enviroment**

**Call: ENV.2008.1.3.1.1 Development of a common methodology and tools to evaluate earthquake hazard in Europe**

## D1.1 - SHARE Work Plan

Due date of deliverable: 1.07.2009
Actual submission date: 1.07.2009

Start date of project: 2009-06-01 Duration: 36

**Swiss Seismological Service, Eidgenössische Technische Hochschule (SED-ETHZ)**

**J. Woessner, D. Giardini**

Revision: 1

| Dissemination Level | | |
|---|---|---|
| | | |
| **PU** | Public | x |
| **PP** | Restricted to other programme participants (including the Commission Services) | |
| **RE** | Restricted to a group specified by the consortium (including the Commission Services) | |
| **CO** | Confidential, only for members of the consortium (including the Commission Services) | |

# SEVENTH FRAMEWORK PROGRAMME

## THEME 6: Environment

**ENV.2008.1.3.1.1 Development of a common methodology and tools to evaluate earthquake hazard in Europe**

**Grant agreement for: Collaborative Project – Medium-scale focused research project**

# *Annex I - "Description of Work"*

Project acronym: *SHARE*
Project full title: Seismic Hazard Harmonization in Europe
Grant agreement no.:226967

Date of preparation of Annex I (latest version): 1.6.09
Date of approval of Annex I by Commission: *15.6.09.*

# Contents page

# PART A

## A.1 Budget breakdown and project summary

### *A.1.1 Overall budget breakdown form A3.2*

| Participant number in this project [9] | Participant short name | Estimated eligible costs (whole duration of the project) | | | | | Total receipts | Requested EC contribution |
|---|---|---|---|---|---|---|---|---|
| | | RTD / Innovation (A) | Demonstration (B) | Management (C) | Other (D) | Total A+B+C+D | | |
| 1 | ETH Zurich | 398,633.33 | 0.00 | 276,000.00 | 96,000.00 | 770,633.33 | 0.00 | 670,975.00 |
| 2 | GFZ | 380,266.67 | 0.00 | 0.00 | 0.00 | 380,266.67 | 0.00 | 285,200.00 |
| 3 | INGV | 473,333.33 | 0.00 | 0.00 | 13,200.00 | 486,533.33 | 0.00 | 368,200.00 |
| 4 | LGIT-UJF | 428,000.00 | 0.00 | 0.00 | 0.00 | 428,000.00 | 0.00 | 303,000.00 |
| 5 | UPAV | 394,666.67 | 0.00 | 0.00 | 72,000.00 | 466,666.67 | 0.00 | 368,000.00 |
| 6 | AUTH | 159,466.67 | 0.00 | 0.00 | 0.00 | 159,466.67 | 0.00 | 119,600.00 |
| 7 | BRGM | 171,500.00 | 0.00 | 0.00 | 0.00 | 171,500.00 | 0.00 | 128,625.00 |
| 8 | CRAAG | 53,333.33 | 0.00 | 0.00 | 0.00 | 53,333.33 | 0.00 | 40,000.00 |
| 9 | IST | 146,666.67 | 0.00 | 0.00 | 0.00 | 146,666.67 | 0.00 | 110,000.00 |
| 10 | KOERI | 146,666.67 | 0.00 | 0.00 | 0.00 | 146,666.67 | 0.00 | 110,000.00 |
| 11 | LNEC | 158,666.67 | 0.00 | 0.00 | 0.00 | 158,666.67 | 0.00 | 119,000.00 |
| 12 | METU | 184,000.00 | 0.00 | 0.00 | 0.00 | 184,000.00 | 0.00 | 138,000.00 |
| 13 | MSO | 66,666.67 | 0.00 | 0.00 | 0.00 | 66,666.67 | 0.00 | 50,000.00 |
| 14 | NERC-BGS | 134,666.67 | 0.00 | 0.00 | 0.00 | 134,666.67 | 0.00 | 101,000.00 |
| 15 | NIEP | 85,333.33 | 0.00 | 0.00 | 0.00 | 85,333.33 | 0.00 | 64,000.00 |
| 16 | NKUA | 66,666.67 | 0.00 | 0.00 | 0.00 | 66,666.67 | 0.00 | 50,000.00 |
| 17 | NORSAR-ICG | 146,666.67 | 0.00 | 0.00 | 0.00 | 146,666.67 | 0.00 | 110,000.00 |
| 18 | ROB | 85,866.67 | 0.00 | 0.00 | 0.00 | 85,866.67 | 0.00 | 64,400.00 |

| Participant number in this project [9] | Participant short name | Estimated eligible costs (whole duration of the project) | | | | | Total receipts | Requested EC contribution |
|---|---|---|---|---|---|---|---|---|
| | | RTD / Innovation (A) | Demonstration (B) | Management (C) | Other (D) | Total A+B+C+D | | |
| TOTAL | | 3,681,066.69 | 0.00 | 276,000.00 | 181,200.00 | 4,138,266.69 | 0.00 | 3,200,000.00 |

## *A.1.2 Project summary form A1*

| Project Number 1 | 226967 | Project Acronym 2 | SHARE |
|---|---|---|---|

| ONE FORM PER PROJECT |
|---|

| GENERAL INFORMATION | | | |
|---|---|---|---|
| Project title 3 | Seismic Hazard Harmonization in Europe | | |
| Starting date 4 | 01/06/2009 | | |
| Duration in months 5 | 36 | | |
| Call (part) identifier 6 | FP7-ENV-2008-1 | | |
| Activity code(s) most relevant to your topic 7 | ENV.2008.1.3.1.1.: Development of a common methodology and tools to evaluate earthquake hazard in Europe | | |
| Free keywords 8 | | Eurocode Europe seismic hazard cyberinfrastructure earthquakes | |

Abstract 9 (max. 2000 char.)

SHARE will deliver measurable progress in all steps leading to a harmonized assessment of seismic hazard – in the definition of engineering requirements, in the collection and analysis of input data, in procedures for hazard assessment, and in engineering applications. SHARE will create a unified framework and computational infrastructure for seismic hazard assessment and produce an integrated European probabilistic seismic hazard assessment (PSHA) model and specific scenario based modeling tools. The SHARE results will deliver long-lasting structural impact in areas of societal and economic relevance, they will serve as a reference for the Eurocode 8 application, and will provide homogeneous input for the correct seismic safety assessment for critical industry, such as the energy infrastructures and the re-insurance sector. SHARE will cover the whole European territory, the Maghreb countries in the Southern Mediterranean and Turkey in the Eastern Mediterranean.

### *A.1.3 List of beneficiaries*

## List of Beneficiaries

| Beneficiary Number | Beneficiary name | Beneficiary short name | Country | Date enter project | Date exit project |
|---|---|---|---|---|---|
| 1 coordinator | Swiss Seismological Service, Eidgenössische Technische Hochschule Zürich | SED-ETHZ | Switzerland | 1 | 36 |
| 2 | GeoForschungsZentrum Potsdam | GFZ | Germany | 1 | 36 |
| 3 | Istituto Nazionale di Geofisica e Vulcanologia | INGV | Italy | 1 | 36 |
| 4 | Laboratoire de Géophysique Interne et Tectonophysique, Université Joseph Fourier | LGIT-UJF | France | 1 | 36 |
| 5 | Università degli Studi di Pavia | UPAV | Italy | 1 | 36 |
| 6 | Aristotle University of Thessaloniki | AUTH | Greece | 1 | 36 |
| 7 | Bureau de Recherches Géologiques et Minières | BRGM | France | 1 | 36 |
| 8 | Centre de Recherche en Astronomie, Astrophysique et Géophysique | CRAAG | Algeria | 1 | 36 |
| 9 | Instituto Superior Técnico | IST | Portugal | 1 | 36 |
| 10 | Kandilli Observatory and Earthquake Research Institute, Bogazici University | KOERI | Turkey | 1 | 36 |
| 11 | Laboratório Nacional de Engenharia Civil | LNEC | Portugal | 1 | 36 |
| 12 | Middle East Technical University | METU | Turkey | 1 | 36 |
| 13 | Montenegro Seismological Observatory | MSO | Montenegro | 1 | 36 |
| 14 | Natural Environment Research Council-British Geological Survey | NERC-BGS | UK | 1 | 36 |
| 15 | National Institute for Earth Physics | NIEP | Romania | 1 | 36 |
| 16 | Seismological Laboratory, University of Athens | NKUA | Greece | 1 | 36 |
| 17 | NORSAR/International Centre for Geohazards | NORSAR-ICG | Norway | 1 | 36 |
| 18 | Observatoire Royal de Belgique | ROB | Belgium | 1 | 36 |

# PART B

## B.1 Concept and objectives, progress beyond state-of-the-art, S/T methodology and work plan

### *B.1.1 SHARE Objectives*

Taking in consideration the identified areas of socio-economic relevance, the existing challenges and present limitations, SHARE will address the following specific objectives:

1. SHARE will build a framework for integration across disciplines, by involving participants, competences and experts spanning all fields from earthquake engineering to geology to engineering seismology, and for integration across national borders, to compile earthquake data and assess seismic hazard without the burden of political constraints and administrative boundaries. An authoritative community model will be assembled by seeking extensive expert elicitation and participation, and through community feedback.

2. SHARE will pursue best practices and high standards in all aspects of seismic hazard assessment, from data collection to the computational framework.

3. SHARE will cover the whole Euro-Mediterranean area (for the Mediterranean we will include in this phase the Maghreb countries to the West and Turkey to the East, but not the Near East and Red Sea areas).

4. SHARE will develop the appropriate computational infrastructure as well as rigorous procedures to qualify and validate all components of the hazard, as a basis for longevity and continuous improvement of a dynamic model ready to incorporate the most recent developments from science and engineering.

5. SHARE will maintain a direct connection to the Eurocode 8 applications and the definition of the Nationally Determined Parameters, through the participation of the CEN/TC250/SC8 committee in the definition of the output specification requirements and in the hazard validation.

6. SHARE will produce direct outputs for risk assessment, enabling the European participation in the Global Earthquake Model program initiated by the OECD.

7. SHARE will focus on the effective dissemination of hazard tools and results.

### *B.1.2 Progress beyond the state-of-the-art*

SHARE will achieve measurable progress beyond the state-of-the-art in all steps leading to a correct assessment of seismic hazard: in definition of engineering requirements, in collection of input data, in their analysis, in procedures for hazard assessment, and in engineering applications.

### *B.1.2.1 Progress in the definition of engineering requirements*

In order to fully meet one key requirement of the Call ("the hazard model should serve as a reference for national zonation as well as seismic safety for the industry sector"), it is paramount to implement an applicative engineering context and flavour to the research and development efforts carried out in this project.

*Baseline*

A critical review of seismic hazard definitions currently employed in different design regulations in Europe and other regions of the world (e.g., United States, New Zealand), together with a well-supported and

justified assessment of possible forthcoming requirements in future design codes and trends, will be carried out and be used as guidance to the remaining efforts of the project.

Up until the very recent past, seismic design codes and practice tended to exclusively use force-based approaches, which required seismic action to be defined in terms of acceleration demand. In addition, and again till very recently, deterministic ultimate limit design approaches were prescribed by codes, through the specification of a single design scenario (usually related to guaranteeing occupancy life safety) to which structures had to comply. Nowadays the inadequacy of acceleration-only based seismic design as a means of controlling damage is widely acknowledged, due both to the poor correlation between transient accelerations and structural damage, and also to the fact that for post-yield response, forces are essentially constant and deformations control the degree of structural degradation and ultimately stability. A significant number of researchers have developed and proposed over the recent years seismic design/assessment methods that place a focus on controlling displacements/deformations that is at least equal to the emphasis placed on ensuring force/stress capacity.

Recent years have also witnessed the introduction of performance-based seismic design (PBSD), essentially the formalization of often-cited objectives of designing structures to withstand minor or frequent earthquake shaking without damage, moderate levels of shaking with only non-structural damage and severe shaking without collapse and a threat to life safety. In the Vision 2000 document (SEAOC, 1995) this is elegantly stated as the "coupling of expected performance level with expected levels of seismic ground motions".

The next generation of seismic design codes is expected to fully incorporate the principles of PBSD, which will require a radical change in the way earthquake actions are specified in such regulations.

*Expected progress and measures of success*

- SHARE will address the issue of defining suitable formats for seismic actions for PBSD, with specific, though not exclusive, reference to Eurocode 8 application documents (Eurocode 8 will become the exclusive seismic design standard throughout the European Community, an area encompassing regions of low and high seismicity, after 2010).
- To ensure the compatibility of the SHARE hazard output specifications with the Eurocode 8 application requirements, we will conduct annual review meetings jointly with the annual meetings of the CEN/TC250/SC8 Committee.
- SHARE will develop seismic hazard models capable of readily and more accurately providing earthquake actions in ways that are appropriate to the estimation of inelastic displacements, since these provide an effective control on damage at different limit states.
- The current practice of defining the loading levels on the basis of the pre-selected, and somewhat arbitrary, return periods will also be carefully scrutinised, and alternative proposals will be presented.

### *B.1.2.2 Progress in the definition of earthquake sources and activity rates*

*Baseline*

Starting in the mid-90s, Europe has recorded a rapid advancement in the compilation of earthquake catalogues, in the understanding of active tectonics and in the implementation of seismogenic source databases. Much of this progress has been fostered by a series of EC programs (e.g., BEECD, FAUST, EPSI, SAFE, PALEOSIS, all completed, and NERIES, ongoing) that not only funded the actual research and the development of new archiving technology, but also promoted a profitable exchange of ideas and methods across European boundaries. Even more recently, the availability of extensive GPS datasets from national or regional networks (e.g., the RING in Italy, TPGN and MAGNET in Turkey, REGAL in France) and increased modelling capabilities have made it possible to derive observations of modern tectonic strain from instrumental data. SHARE will achieve progress in all areas related to the characterization of earthquake sources and activity rates.

***Earthquake datasets and magnitude calibration***

*Baseline*

The work will build on ongoing initiatives which already deal with the problem of creating homogeneous, European seismicity datasets, i.e. (1) the EC funded NERIES activity "Distributed archive of historical earthquake data" and its extension to other European countries, currently under development in the frame of a Working Group of the European Seismological Commission; (2) the program undertaken by GFZ for homogenizing to $M_w$ the magnitude of all $M_w$>3.5 European earthquakes north of 44°N and for all M>5 earthquakes in southern Europe and the Mediterranean (Grünthal and Wahlström, 2007); (3) the initiatives at European scale of the EMSC, among others in the EC EPSI project, to compile homogeneous European bulletins since 1998.

*Expected progress and measures of success*

- SHARE will provide the most reliable and homogeneous seismicity dataset at the European scale, covering historical and modern instrumental seismicity. We will achieve this by assessing calibration relationships on a regional basis, in order to supply uniform and seismic hazard usable magnitudes ($M_S$, $M_L$) standardized to moment magnitude ($M_W$).
- To harmonize the quantification of earthquake size, we will adopt common and homogeneous ground-motion attenuation models (NGA-type with homogeneous site corrections, WP4), leading to a close compatibility between magnitude values used in the hazard model and the ground motion model.
- For the first time, SHARE will also focus on offshore seismic areas (e.g., Mediterranean and north-east Atlantic), as well as on polar regions, which are difficult areas to deal with but are of growing importance as to seismic risk issues.

***Seismogenic sources and geological constraints***

*Baseline*

In the past two decades, active fault data and geological constraints have increasingly been used in seismic hazard assessment in all most tectonically active areas of the world (New Zealand: Stirling et al., 2002; Canada: Adams and Halchuk, 2003; Italy: Meletti et al., 2008). Although the basic strategies in collecting, interpreting and using these types of data have enormously improved at a local and sometimes regional scale, the main challenge for this task is to make a step forward in using them in a continent-wide scale.

*Expected progress and measures of success*

- SHARE will collect and harmonise data on seismogenic sources – active faults capable of generating earthquakes above a threshold magnitude Mw ≥ 5.5 – over all main tectonically active zones in the Euro-Mediterranean area. Major tectonic features, such as plate boundaries or main transfer faults will also be taken into consideration, even if they do not fall into the above definition. This will provide a set of fully parameterized seismogenic sources based on geological/geophysical data independent from those collected in other tasks.
- All data will be in parametric form, following a standardized scheme, and in map form. We will for the first time standardize all steps required to build a homogeneous database: the definition of the shared database platform and the standardization of the fault parameters; the collection of parametric data, the criteria to perform tectonic and seismic validation of the data and to characterize uncertainties of those parameters that most affect the hazard calculation (i.e., maximum magnitude and slip rate; the classification of documentation supporting the parametric data; the tools to visualize the database consistency, analyzing the uncertainties associated); and the criteria to integrate the identified active faults and seismogenic sources into the seismic source zones used for hazard computation.

***Strain- and slip-rate model***

*Baseline*

Strain and slip rates of European faults have already been quantified based on regional geodynamic models at various levels of complexity (e.g., Barba et al., 2008). The advantages of these models are that (a) they return realistic estimates of slip rates over large regions even in the absence of direct (e.g., paleoseismological) observations of fault slip, (b) they provide upper bounds to the total strain rate and seismic moment release predicted by the seismicity model, thereby allowing the validation of the internal hazard consistency, and (c) they do so by exploiting a large number of observations that are normally not directly incorporated in seismic hazard (e.g., stress and plate motion data, geodetic data).

*Expected progress and measures of success*

- SHARE will develop a prototype reference strain and slip-rate finite-element model at the European scale. Our model will be specifically designed to serve as validation for hazard assessments, using consistent geometries of the source zones as well as homogeneous definition of the earthquake parameters (i.e., magnitude scale, regional distribution of hypocentral depths). Large-scale geological structures, seismogenic sources, geodetic vectors and subsidence/uplift rates will be incorporated into the model, serving as a benchmark for the model results thorough the investigated area. The model will integrate different tectonic settings, including subduction, plate convergence, rift systems (including aborted ones), passive continental margins, as well as glacial-isostatic adjustments.

***Seismic Source Zones (SSZ)***

*Baseline*

Europe is made up of strongly varying seismogenic regions with large contrasts and complexity, and displaying quite different properties, background information, data coverage, and data availability. This has resulted in a very inhomogeneous definition of seismic source models across Europe. A first uniform SSZ model was produced in the SESAME/ESC project in 2000.

*Expected progress and measures of success*

- We will construct a homogeneous model of seismic source zones combining data on large-scale geological structure, seismotectonics, seismogenic faults, observed seismicity (instrumental, pre-instrumental, and paleoseismological), and geodesy. For the first time, all SSZs in the European model will be assigned a statistical distribution of the predominant focal mechanism orientation, of the earthquake hypocentral depth and of the Maximum magnitude Mmax, in order to provide adequate control for the selection of the ground-motion attenuation model and to improve the accuracy in the hazard computations. The unified model will consider the epistemic uncertainties in the seismic source zones by applying the logic tree approach for the first time at European scale, to encompass different interpretations. This is particularly important for fault models in terms of choosing between different interpretations of fault sources and area sources by considering the moment rate comparisons.

***Earthquake activity rates***

*Baseline*

Statistical tools are commonly applied in hazard assessment, but not in a homogeneous way across Europe.

*Expected progress and measures of success*

- SHARE will apply for the first time common statistical techniques at European scale to derive the required parameters describing the rates at which each seismic source zone has generated earthquakes of different magnitudes in the past, which are then taken as the expected probabilities to generate future earthquakes for use in the assessment of hazard. The key parameters – the activity rate, the b-value, and the maximum magnitude Mmax distribution – will be assessed in a pan-European exercise, using harmonized methodologies. The regional earthquake catalogues and the defined seismic source zone geometries will be used to derive magnitude-dependent catalogue completeness, to de-cluster aftershocks, to fix prior-distributions of maximum magnitudes and to evaluate statistical uncertainties.

- An innovative part of the work will be the implementation of checks on (a) geological and strain-rate constraints, and (b) internal consistency with regard to historical experienced shaking, to ensure that the models used for evaluating expected seismic activity is well balanced and harmonized throughout all of the regions in Europe.

### *B.1.2.3. Progress in strong ground motion modelling*

*Baseline*

Several strong motion models have been published in the recent past, and each national hazard assessment project usually still uses its own preferred model or combination of models, or derives a model calibrated often on limited local data. SHARE will enable major progress in this area, delivering the first consensus model of ground motion attenuation on rock for the Euro-Mediterranean region, together with site corrections calibrated for regional applications.

***Ground Motion Prediction Equation on rock***

*Baseline*

In the last 5 years, a few key European experts have made seminal contributions to a new understanding of strong ground motions (i.e., NGA), with a new focus on characterizing the site conditions at the recording stations, the rock site definition for Ground Motion Predictions Equations (GMPE) and the regional adjustments.

*Expected progress and measures of success*

- SHARE will produce the first consensus rock motion model for the European-Mediterranean region, based on a new pan-European compilation of well-calibrated strong- and weak-motion records, on the incorporation of well-calibrated waveforms from key earthquake databases from other region of the world (to complement the European data coverage in the near-field and high magnitude range), on the critical evaluation and selection of published models, and on the definition of a logic tree combining different model realizations and expert opinions. The approach used by SHARE to derive the model will be innovative in itself, as SHARE will bring together the best recognized experts in a single group and will charge them to critically analyze options and derive a model logic tree covering the Euro-Mediterranean region. We will also systematically evaluate regional effects (e.g., the Vrancea region, subduction zones around the Aegean Sea, oceanic crust in Portugal etc.)

***Site effects***

*Baseline*

Eurocode 8 recommends a site classification based on the average S-wave velocity over the uppermost 30 meters (Vs30 below), and two families of spectral shapes depending on the seismic activity level of area (Type I for active areas, and Type II for moderately active areas). Leaving aside the issue of rock spectrum, the survey of national annexes describing the local, national implementations of EC8 indicates that there is no European consensus either on the criteria to be used for site classification – although a majority of countries has accepted Vs30, in the absence of any serious other proposition – or on the spectral shapes for the different site categories.

*Expected progress and measures of success*

- SHARE will achieve progress along two directions: (1) keeping the EC8 site classification criteria unchanged and proposing the corresponding "optimal" spectral shapes and/or amplification factors, and (2) exploring new tracks for new site classification, and proposing site amplification factors accordingly.

***Alternative ground motion parameters***

*Baseline*

The increase of computational power and the development of numerical methods enable the direct use of acceleration time histories in the study of linear and nonlinear dynamic behaviour of structures. At the same

time, recent observations have shown that empirical models do not capture ground motion specificities in some cases (near fault effects, 3D basin effects) and several numerical methods have then been developed to simulate time histories in such local and complex settings.

*Expected progress and measures of success*

- SHARE will provide the earthquake engineering community with new methods to obtain observed reference time histories specific to EC8 soil classes and European crustal conditions.
- We will develop new methodologies to include seismological simulations within PSHA studies, to help ensure the coherency between region specific simulations and PSHA maps derived at a European scale within this project. Some specifies areas (e.g., Wallis, Grenoble basin) will be chosen in order to test and validate these new ideas.

### *B.1.2.4. Progress in the assessment of seismic hazard*

SHARE will achieve progress beyond state-of-the-art on several fronts in the assessment of Probabilistic Seismic Hazard.

***Work across boundaries***

*Baseline*

Seismic hazard is traditionally assessed at national scale and within national boundaries, to serve as input for various regulatory applications, making it impossible to achieve regional harmonization, for lack of data or limited geographical extent. The previous European project SESAME/ESC was a first attempt to work at the integrated Euro-Med scale.

*Expected progress and measures of success*

- National experts will participate with their knowledge in building regional consensus models, transcending the traditional administrative and disciplinary boundaries.

***Formal elicitation of expert opinions***

*Baseline*

Combining the models and opinions of more than one hundred experts from various disciplines requires a structured mechanism for elicitation, to ensure that the different expert opinions can be represented in a composite model. Much progress has been achieved in formalizing the process by which consistent hazard estimates can be obtained for critical facilities. The SSHAC (Senior Seismic Hazard Analysis Committee) guidance has been developed to provide technical and procedural guidance on how to perform a consistent PSHA.

*Expected progress and measures of success*

- SHARE will adopt, for the first time in a regional study of this dimension in Europe, a uniform SSHAC Level-3 procedure, adapted to the needs of the present project. In SHARE, both the WP leaders (in their role as Technical Integrators) and the experts will share the responsibility and intellectual ownership of the results. The additional responsibility of the WP leaders will be formalized in WP5.

***Full treatment of aleatory and epistemic uncertainties***

*Baseline*

In recent high-level PSHA studies it has become evident that the mean hazard results are driven to high values at low probabilities by the high uncertainties associated to ground-motion models and other input data for hazard. The standard practice in the seventies and eighties was to include only a reduced variability of the strong-motion models, or even to exclude it entirely, a practice that was also facilitated by an incorrect application of deterministic hazard assessment. A debate is presently raging on the need to separate uncertainties in epistemic (the part of uncertainty which can be reduced with additional information – e.g.

site characterization at the strong-motion stations) from the aleatory variability (the part of uncertainty which cannot be reduced with additional information – e.g. the intrinsic complexity of the seismic source) and how this should be done.

*Expected progress and measures of success*

- SHARE will systematically approach these issues with the goal of avoiding double-counting effects that tend to increase the variability spread (e.g., including the site variability both in the strong-motion recording and in the site correction), and build the whole hazard model in a logic tree formulation, expressing the composite opinion of the technically informed community and the correct formulation of uncertainties.

***Computational infrastructure***

*Baseline*

Hazard computation capability and codes are available at numerous centres and locations throughout Europe, but we are missing a common controlled computational infrastructure, where all steps in the preparation of the input data, in the definition of input files and of interfaces between the different groups delivering inputs for hazard computation, and in the validation of the results, are formalized and harmonized.

*Expected progress and measures of success*

- We will develop a single computational infrastructure based on full accessibility and open availability of data, tools and products, through a dedicated Portal fully connected with the portal for seismological data developed by the EMSC within the NERIES project. The software will be also open to be ported and installed in other centers, once fully tested and operational. The infrastructure will be developed so that it can remain functional after the formal end of SHARE, and continue to operate as regional center within the framework of the Global Earthquake Model program initiated by the OECD.

### *B.1.2.5. Progress in engineering applications*

In addition to the products described in the Engineering Requirement section (1.2.1) and to the overall impact expected in the engineering and industry communities (see section 3), SHARE will achieve progress on two specific applications.

***Definition of a consensus reference European seismic hazard zonation***

*Baseline*

At present, each nation of Europe has its own seismic hazard zonation as input for the building code. These maps have been obtained independently in each country and reveal serious discrepancies at border (up to 50% in reference PGA values).

*Expected progress and measures of success*

- We will draw a consensus reference zonation of the European territory, to serve as a reference for the homogeneous national mapping of the anchoring peak acceleration on rock, required for the definition of the National Annexes to EN 1998-1 in preparation for the full application of for Eurocode 8. While this new pan-European mapping will not be binding for the application, it will nonetheless provide the first uniform European reference.

***Risk scenarios***

*Baseline*

Exposure data and vulnerability assessment methods have been developed and fine-tuned over the recent years in previous European projects (e.g., FP5 Risk-UE and FP6 LESSLOSS). A number of projects have also focussed on developing risk scenario assessment capabilities.

*Expected progress and measures of success*

- A set of trial risk assessment applications at large geographical scales will be carried out, in order to obtain an appreciation of what may be the implications, in terms of risk to human life and direct/indirect financial losses, of the introduction of the new hazard models and definitions developed in SHARE.

### *B.1.3 S/T methodology and associated work plan*

#### *B.1.3.1 Overall strategy of the work plan*

The overall strategy of SHARE is to start with defining the engineering requirements to guide in assembling the required databases and scientific and technical knowledge for the assessment of earthquake occurrence probabilities and of ground-motion models. These models will be combined in the assessment of seismic hazard, performed in a quality-controlled computational infrastructure. The hazard models in turn will serve as input for engineering applications and for dissemination to the wider community (Figure 1).

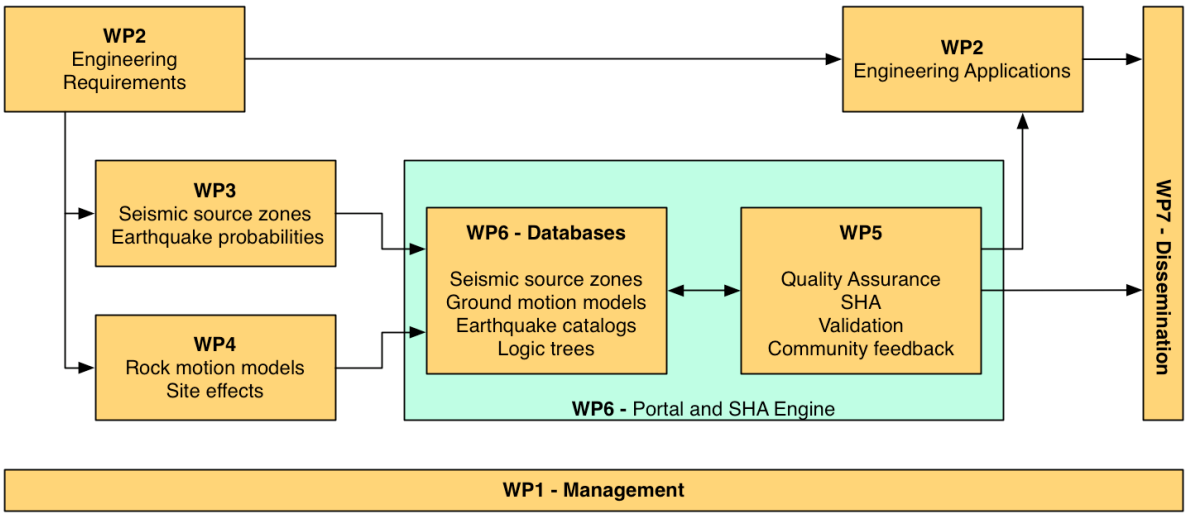



**Figure 1:** SHARE project workflow. WP2 defines engineering requirements that inform the work on defining seismic source zones and earthquake probabilities (WP3) and the rock motion models and models of localized site effects (WP4). These models and parameters are held within a series of four databases developed under WP6, which also develops the SHA engine for computation and the Portal for disseminating project results (blue box). Inside the computational engine, WP5 performs the seismic hazard assessment itself and subjects it to quality assurance and validation, including community feedback. The results of the seismic hazard assessment update the databases in WP6 and are used in scenario modeling under the Engineering Applications aspect of WP2. The scenarios, the seismic hazard assessment, the underlying databases, and all derived products are disseminated via the SHARE Portal through the efforts of WP7.

SHARE is designed according to the following principles.

–Ensure **integration across disciplines** by involving participants, competences and experts spanning all fields from geology, geodesy, earthquake engineering, and engineering seismology, to pursue high technical standards and better practice

–Build a framework for **cooperation across national borders** to compile earthquake data and assess seismic hazard without the burden of political constraints and administrative boundaries, to move beyond the national dimension in building a true pan-European hazard expert community

–**Build on past European projects** (e.g., FAUST, BEECD, EPSI, SAFE, PALEOSIS, ORCHESTRA) and enable the **integration of on-going programs**, including European projects (e.g., NERIES, SAFER) and on-going national and regional efforts (e.g., in Algeria-Maghreb and in the Balkans)

–Build an **authoritative community mode**l by extensive consensus elicitation and participation of national and thematic experts, and by community feedback validation

–Pursue **scientific and technical innovation** by including the most recent developments in geological and geodetic input, New Generation Attenuation models, assessment of site conditions, testing of simulation-based hazard in complex tectonic environments, coverage of ocean and polar

regions, full treatment of aleatory and epistemic uncertainties, formal elicitation procedures, and logic tree representation of the whole hazard model

–Build a **quality-controlled computational infrastructure** for Europe on a par with similar initiatives in the United States

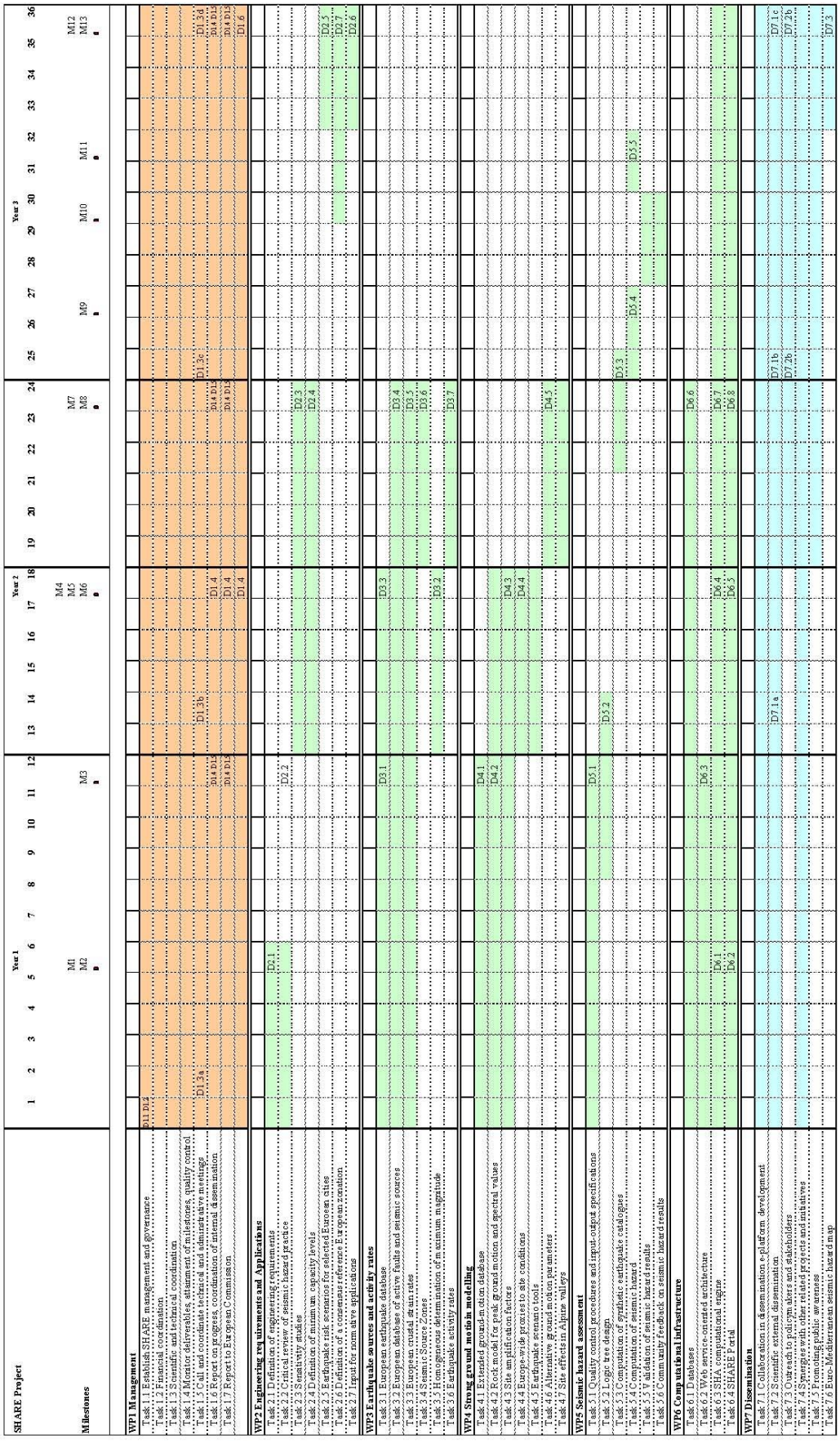
–Maintain a direct connection to **EC8 applications** through the participation of the EC8 CEN/TC250/SC8 committee in the definition of the output specification requirements and in the hazard validation

–Achieve full coverage of the **whole Euro-Mediterranean area** (including the Maghreb countries in the S. Mediterranean and Turkey to the east; Near East areas will be added through additional efforts within the GEM/OECD framework)

–Produce direct outputs for **risk assessment**, enabling European participation in the OECD Global Earthquake Model program

–Focus on **effective dissemination** with a dedicated work package (WP7)

## *B.1.3.2 Timing of work packages and their components*



### *B.1.3.3 Work package list*

| Work package No. | Work package title | Type of activity | Lead participant No | Lead participant short name | Person-months | Start month | End month |
|---|---|---|---|---|---|---|---|
| 1 | Management | MGT | 1 | SED-ETHZ | 36 | 1 | 36 |
| 2 | Engineering requirements and applications | RTD | 5 | UPAV | 85 | 1 | 36 |
| 3 | Earthquake sources | RTD | 3 | INGV | 178 | 1 | 30 |
| 4 | Strong-ground motion model | RTD | 4 | LGIT-UJF | 93 | 1 | 24 |
| 5 | Seismic hazard assessment | RTD | 2 | GFZ | 39 | 1 | 32 |
| 6 | Computational infrastructure | RTD | 1 | SED-ETHZ | 41 | 1 | 36 |
| 7 | Dissemination | OTHER | 5 | UPAV | 13 | 1 | 36 |
| | | | | TOTAL | 485 | | |

### *B.1.3.4 Deliverable list*

| Del. No. | Deliverable name | WP no. | Lead beneficary | Estimated indicative pers. month | Nature | Dissemi-nation level | Delivery date (proj. month) |
|---|---|---|---|---|---|---|---|
| D1.1 | SHARE Work Plan | 1 | SED-ETHZ | 1 | O | PU | 1 |
| D1.2 | SHARE Consortium Agreement | 1 | SED-ETHZ | 1 | O | PU | 1 |
| D1.3a | Project startup meeting | 7 / 1 | SED-ETHZ | 2 | R | PU | 2 |
| D1.4 | Technical and administrative reports periodically<br>Internal consortium reports | 1 | SED-ETHZ | 19 | R | PP | 18 and 36<br>12 and 24 |
| D1.5 | Outcome reports of annual General Assembly and Scientific Advisory Board meetings | 1 | SED-ETHZ | 6 | R | PP | Annually |
| D2.1 | Hazard output specifications requirement document, jointly approved with EC8 Committee | 2 | LNEC | 8 | R | PU | 6 |
| D6.1 | OpenSHA design specifications document | 6 | SED-ETHZ | 2 | R | PP | 6 |
| D6.2 | Portal design specifications document | 6 | BRGM | 2 | R | PP | 6 |
| D2.2 | Report on seismic hazard definitions needed for structural design applications | 2 | UPAV | 8 | R | PU | 12 |
| D3.1 | Compilation of existing regional and national seismic source zones | 3 | GFZ | 28 | O | PU | 12 |
| D4.1 | Updated strong ground motion database | 4 | METU | 25 | O | PU | 12 |
| D5.1 | Input specifications for seismic hazard computation | 5 | SED-ETHZ | 5 | R | PP | 12 |
| D6.3 | Web service-oriented architecture providing access to all databases | 6 | BRGM | 5 | P | PP | 12 |
| D5.2 | Structure of the logic tree to be used in seismic hazard computation | 5 | GFZ | 5 | O | PU | 14 |
| D1.3b | Project General Assembly | 7 / 1 | SED-ETHZ | 2 | R | PU | 14 |

| Del. No. | Deliverable name | WP no. | Lead beneficary | Estimated indicative pers. month | Nature | Dissemi-nation level | Delivery date (proj. month) |
|---|---|---|---|---|---|---|---|
| D7.1a | Dissemination e-newsletter | 7 | UPAV | 1 | R | PU | 14 |
| D3.2 | Updated European earthquake catalogue, with homogeneous magnitude calibration | 3 | GFZ | 28 | O | PU | 18 |
| D3.3 | Regional map of Mmax and associated database | 3 | INGV | 24 | O | PU | 18 |
| D4.2 | Regionally adjusted Ground Motion Prediction Equations (GMPE) for Europe | 4 | METU | 29 | R | PU | 18 |
| D4.3 | New site classification scheme and associated site amplification factors | 4 | LGIT-UJF | 17 | O | PU | 18 |
| D4.4 | European Vs30 map derived from surface topography slope and site calibrations | 4 | LGIT-UJF | 10 | O | PU | 18 |
| D6.4 | Initial OpenSHA engine | 4 | SED-ETHZ | 5 | P | PP | 18 |
| D6.5 | Initial Portal implementation | 6 | SED-ETHZ | 8 | P | PP | 18 |
| D2.3 | Recommendations from study on the influence of hazard return period in design codes | 2 | UPAV | 12 | R | PU | 24 |
| D2.4 | Study on minimum hazard levels for explicit structural seismic analysis and design | 2 | UPAV | 17 | R | PU | 24 |
| D3.4 | Database of active faults and seismogenic sources | 3 | INGV | 36 | O | PU | 24 |
| D3.5 | Reference strain rate models for the Euro-Mediterranean region | 3 | INGV | 25 | O | PU | 24 |
| D3.6 | Logic tree of seismic source zones | 3 | INGV | 24 | O | PU | 24 |
| D3.7 | Logic tree of earthquake activity rates | 3 | NERC-BGS | 13 | O | PU | 24 |
| D4.5 | Vector predictions SMD, AI, Fc, and Fb | 4 | LGIT-UJF | 12 | O | PU | 24 |
| D6.6 | Databases of seismogenic zones, Mmax, earthquake activity rates, ground-motion attenuation relations, and associated | 6 | SED-ETHZ | 7 | O | PU | 24 |

| Del. No. | Deliverable name | WP no. | Lead beneficary | Estimated indicative pers. month | Nature | Dissemi-nation level | Delivery date (proj. month) |
|---|---|---|---|---|---|---|---|
| | logic trees | | | | | | |
| D6.7 | Operational SHARE Portal | 6 | SED-ETHZ | 6 | O | PU | 24 |
| D6.8 | Validated OpenSHA engine | 6 | SED-ETHZ | 6 | O | PP | 24 |
| D5.3 | Suite of synthetic earthquake catalogues, computed according to different branches of the hazard logic tree | 5 | GFZ | 8 | O | PU | 25 |
| D1.3c | Project General Assembly | 7 / 1 | SED-ETHZ | 2 | R | PU | 25 |
| D7.1a | Brochures for policymakers and stakeholders | 7 | SED-ETHZ | 4 | R | PU | 25 |
| D7.1b | Project electronic newsletter | 7 | INGV | 1 | R | PU | 25 |
| D5.4 | First-round regional seismic hazard assessment including de-aggregation and validation | 5 | GFZ | 10 | R | PU | 27 |
| D5.5 | Final seismic hazard assessment including de-aggregation | 5 | SED-ETHZ | 11 | R | PU | 32 |
| D1.3d | Project General Assembly | 7 / 1 | SED-ETHZ | 2 | R | PU | 36 |
| D1.6 | Final reports including the final plan for use and dissemination and the report on awareness and societal implications | 7 / 1 | SED-ETHZ | 1 | R | PU | 36 |
| D2.5 | Seismic loss scenarios for sample European cities and regions | 2 | AUTH | 12 | R | PU | 36 |
| D2.6 | Suggestions for updates to European seismic design regulations | 2 | UPAV | 8 | R | PU | 36 |
| D2.7 | Consensus reference Euro-Mediterranean seismic hazard zonation | 2 | UPAV | 20 | R | PU | 36 |
| D7.1c | Project electronic newsletter | 7 | INGV | 3 | R | PU | 36 |
| D7.2b | Brochures for policymakers and stakeholders | 7 | UPAV | 1 | R | PU | 36 |
| D7.3 | Euro-Mediterranean seismic hazard map | 7 | SED-ETHZ | 3 | R | PU | 36 |

### *B.1.3.5 Work package descriptions*

| **Work package number** | 1 | **Start date or starting event:** | | 1 | | | |
|---|---|---|---|---|---|---|---|
| **Work package title** | Management | | | | | | |
| **Activity Type** | Consortium management | | | | | | |
| **Participant number** | 1 | | | | | | |
| **Participant short name** | SED-ETHZ | | | | | | |
| **Person-months per participant:** | 36 | | | | | | |

**Objectives**

This work package is designed to oversee the administrative and financial management and to ensure financial and scientific/technical coordination, project planning and evaluation of the project in progress. These tasks include monitoring of the flow of work and fostering the flow of information between the participants and between the different work packages. In addition, the project management provides the communication to the European commission.

**Description of work** and role of participants

*Task 1.1. Establish SHARE management and governance*

Negotiate the Work Plan with the EC. Prepare the Consortium Agreement. Install the SHARE Manager (70%) and the Project Office, providing administrative (15%) and financial (15%) assistance to the project Manager and Coordinator. Initiate all activities of the Management Committee.

*Task 1.2. Financial coordination (Coordinator, Manager, Project Office)*

All financial issues related to budget allocation; control of cost consistency; preparation of required financial reports; responding to audits; and contacts with representatives of the EU.

*Task 1.3. Scientific and technical coordination (Coordinator, Management Committee)*

Coordination of the research effort in order to optimize liaisons between participants, guarantee effective transfer of knowledge within the research teams and efficient coordination of all work packages.

*Task 1.4. Monitor deliverables, attainment of milestones, quality control (Manager, Coordinator)*

Quarterly reporting of project progress from the work package leaders to the project office and the Management Committee. Quality control covering project documents and approval of input-output specifications, to be achieved via the dedicated project web site.

*Task 1.5. Call and coordinate technical and administrative meetings (Manager, Coordinator)*

Coordination of SHARE kick-off meeting, quarterly teleconferences and bi-annual meetings of the Management Committee, annual General Assemblies, and annual meetings

of the Scientific Advisory Board.

*Task 1.6. Progress reporting, coordination of internal dissemination (Manager, Coordinator)*

Intermediate reports as well as internal reports to be distributed among participants in order to inform the different units of on-going activities and meetings and on the progress of concomitant research and ensure continuous links among the different activities. Interaction with participants and the project's web site will be used for this goal. Annual plenary meetings will be scheduled and carried out; kick-off, first year, second year, and final meetings. All project partners will take part and present progress reports, under the coordination of the respective work-package leaders. This will ensure the entire consortium is aware of progress and results being achieved and issues to be addressed, and will stimulate sharing of ideas, constructive criticism, and optimisation of resources. Work package leaders will also server as responsible for intra-WP dissemination efforts, thus internal workshops for discussing, planning and reviewing the activity.

*Task 1.7. Reporting to the European Commission (Coordinator)*

The Project Coordinator will report to the Commission on financial and project progress as required in the agreement with the Commission.

**Deliverables**

D1.1. SHARE Work plan (approved in the EC negotiation prior to project start)

D1.2. SHARE Consortium Agreement (signed by Consortium prior to project start)

D1.3 (a-d). Months 2, 14, 25, 36. Project startup meeting and General Assemblies

D1.4. Technical and administrative annual reports at months 12, 18, 24, and 36

D1.5. Outcome reports of annual General Assembly and the Scientific Advisory Board Council meetings

D1.6. Final reports

| **Work package number** | 2 | **Start date or starting event:** | | 1 | | |
|---|---|---|---|---|---|---|
| **Work package title** | Engineering requirements and applications | | | | | |
| **Activity Type** | RTD | | | | | |
| **Participant number** | 5 | 11 | 6 | 10 | 4 | 1 | 13 |
| **Participant short name** | UPAV | LNEC | AUTH | KOERI | LGIT -UJF | SED- ETHZ | MSO |
| **Person-months per participant:** | 52 | 12 | 12 | 4 | 2 | 2 | 1 |

**Objectives**

To provide the necessary engineering application context for the development of the homogeneous hazard zonations and products that are the main aim of the SHARE, so as to help focusing development efforts and also warrant practical applicability and value to the results attained.

To ensure the compatibility of the SHARE hazard output specifications with the Eurocode 8 application requirements and to help the harmonization of the Nationally Determined Parameters for the definition of the National Annexes to EN 1998-1.

To conduct trial risk assessment applications, at large geographical scales, considering the developed hazard maps, in order to understand what the implication of the introduction of such new hazard definitions may be for the engineering community and also society as a whole (human and economic losses will both be estimated).

To create the technical and knowledge base for the participation of the Euro-Mediterranean region in the Global Earthquake Model program initiated by the OECD.

**Description of work** and role of participants

*Task 2.1. Definition of engineering requirements (LNEC, UPAV*)

To ensure the compatibility of the SHARE hazard output specifications with the Eurocode 8 application requirements, we will conduct annual review meetings jointly with the annual meetings of the CEN/TC250/SC8 Committee (LNEC hosts the Secretariat of the Eurocode 8 Committee). A first meeting will serve to draft a hazard output specification requirement document; a second meeting to report progress, a third meeting to review and validate the hazard products. Hazard output specifications will include ground-motion parameters, damping, return periods, frequencies and all other specifications to ensure that the pan-European seismic hazard results can be applied to improve and harmonize the Nationally Determined Parameters in the national code applications.

*Task 2.2. Critical review of seismic hazard practice (UPAV)*

Critical review of seismic hazard definitions currently employed in different design regulations in Europe and other regions of the world (e.g., United States, New Zealand), together with a well supported and justified assessment of possible forthcoming requirements in future design codes and trends.

*Task 2.3. Sensitivity studies (UPAV, LNEC)*

Sensitivity studies to analyse the influence that different choices of reference return periods in design codes (e.g., Eurocode 8, United States regulations, New Zealand codes) might have in reliability levels of different typological structural systems (e.g., buildings and bridges).

*Task 2.4. Definition of minimum capacity levels (UPAV)*

Definition, through probabilistic structural assessment, of (possibly displacement-based) minimum structural capacity levels, below which the explicit definition of seismic hazard is not necessarily required.

*Task 2.5. Earthquake risk scenarios for selected European cities (UPAV, LNEC, AUTH, KOERI)*

Seismic risk/loss assessment scenarios for selected European regions (Algarve region, Italy) or cities (Istanbul, Lisbon, Messina, Thessaloniki) considering seismic hazards maps currently employed in those regions as well as the new hazard model developed and proposed in the current project, with a view to better appreciate and scrutinise the consequences, in terms of practical design application/assessment and seismic risk evaluation/mitigation policies, of the introduction of a new European seismic hazard model.

*Task 2.6. Definition of a consensus reference European zonation (UPAV, LNEC, AUTH, KOERI, IST, MSO)*

Starting from the hazard results obtained in WP5, draw a consensus reference zonation of the European territory, to serve as reference comparison for the homogeneous national mapping of the anchoring peak acceleration on rock for the definition of the National Annexes to EN 1998-1 in preparation for the full application of for Eurocode 8.

*Task 2.7. Input for normative applications (UPAV)*

Summary of the main implications, for seismic structural design and its codification, of the findings obtained in the current endeavour.

**Role of participants**

UPAV (5) will coordinate WP2 and will be involved in all its tasks.

LNEC (11) will be primarily responsible to ensure the coordination with the CEN/TC250/SC8 Committee of Eurocode 8 and will participate in the scenario modeling (2.5) and in drawing the consensus reference zonation (2.6).

AUTH (6) will participate in the scenario modeling and in drawing the consensus reference zonation (2.6), and will be primarily responsible to ensure the interface with the site assessment calibration in WP4.

KOERI (10) will participate in the scenario modeling (2.5) and in drawing the consensus reference zonation (2.6).

LGIT-UJF (4) will participate in key meetings and discussions to ensure consistency with specifications in WP4.

MSO (13) will participate in drawing the consensus reference zonation (2.6) for the Balkans region.

SED-ETHZ (1) will participate to define a European-wide reference zonation map (2,6).

**Deliverables**

D2.1. Month 6. Hazard output specifications requirement document, jointly approved with EC8 Committee

D2.2. Month 12. Report on seismic hazard definitions needed for structural design applications.

D2.3. Month 24. Recommendations from study on the influence of hazard return period in design codes

D2.4. Month 24. Results from study on minimum hazard levels for explicit structural seismic analysis and design

D2.5. Month 36. Seismic loss scenarios for sample European cities and regions

D2.6. Month 36. Suggestions for possible updates to European seismic design regulations.

D2.7. Month 36. Consensus reference Euro-Mediterranean seismic hazard zonation

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Work package number** | 3 | **Start date or starting event** | 1 | | | | |
| **Work package title** | Earthquake sources and activity rates | | | | | | |
| **Activity Type** | RTD | | | | | | |
| **Participant number** | 3 | 6 | 14 | 2 | 9 | 10 | 15 |
| **Participant short name** | INGV | AUTH | NERC-BGS | GFZ | IST | KOERI | NIEP |
| **Person-months per participant** | 52 | 7 | 13 | 22 | 12 | 10 | 15 |
| | | | | | | | |
| **Participant number** | 16 | 17 | | 18 | 8 | 13 | 1 |
| **Participant short name** | NKUA | NORSAR-ICG | | ROB | CRAAG | MSO | SED-ETHZ |
| **Person-months per participant** | 8 | 14 | | 7 | 11 | 5 | 2 |

**Objectives**

To supply harmonized earthquake input data at European level for the SHARE project, and specifically a new homogeneous earthquake catalogue

To construct a European model of seismic source zones (SSZ) for input to the seismic hazard computations

To integrate the knowledge gained in specific programs and national efforts in a wider, coordinated European context

To use geological and geodetic evidence in a homogeneous framework to provide additional constraints for constructing seismic source zones and for assessing earthquake activity rates

To build European-wide consensus and ownership of the input data and modeling approaches, through the direct participation of national and thematic experts in the elicitation of the required knowledge and the construction of the models

**Description of work** and role of participants

WP3 contains data collection and data elaboration tasks. In order to ensure geographical completeness, the work will proceed in predefined regions, covering the whole Euro-Mediterranean region (in this phase, our coverage of the Mediterranean includes the Maghreb countries to the West, and extends to Turkey to the East, excluding the Near-East and Red-Sea areas), and will be supported by key institutions acting as regional

coordinators responsible for homogeneous data collection and interpretation. The regional coordinators are identified as follows:

– Greece, Turkey and Eastern Mediterranean: AUTH, NKUA and KOERI

– Ibero-Maghreb region and associated Atlantic and W. Mediterranean offshore: IST and CRAAG

– Central and Western Europe: ROB and GFZ

– Balkans: MSO and NIEP

– Scandinavia and Polar region: NORSAR-ICG

– Central Mediterranean: INGV

– North Sea and Atlantic offshore: NERC-BGS

The work in the individual regions will take place through dedicated workshops, where experts from all countries in the region will convene to compile relevant data and models to be considered in assembling the regional models. Two workshops are foreseen for each region, for the compilation of the datasets and the evaluation of the seismic source models. A final workshop at European scale will then be conducted during the validation phase to evaluate the results of the hazard modeling. The resources required to ensure wide participation in the workshops are allocated to the regional coordinators. The harmonization of all the earthquake data will benefit from the results of two on-going projects in the Balkans and Maghreb, and resources allocated in SHARE to the local coordinators (MSO and CRAAG) will allow to harmonize the inputs and results across the whole region.

The regional coordinators will come together to integrate and harmonize the results of the individual regions and build databases and models at the Euro-Mediterranean scale. We expect that additional countries in the Southern Mediterranean and Near East region will be covered by other efforts within the GEM/OECD framework, and coordinated with SHARE.

*Task.3.1. European earthquake database (INGV, AUTH, NERC-BGS, GFZ, IST, KOERI, NIEP, NKUA, NORSAR/IGC, ROB, MSO, CRAAG)*

Based on the existing expertise on the retrieval, elaboration and handling of information on earthquake data, produce a unified, continent-wide dataset of earthquake data. We will achieve this by blending existing historical datasets and reassessing calibrated magnitudes with support from several institutions and national catalogues. The Task will integrate the results of the EC I3 project NERIES for all European earthquakes with M>5, the result of an on-going project lead by GFZ to produce a homogeneous catalogue of earthquakes with M>3.5 in the central-northern European region, and the homogeneous catalogue produced by EMSC since 1998 (initiated under the EPSI project). The resulting catalogue will be tested for completeness through homogeneous procedures.

*Task 3.2. European database of active faults and seismogenic sources (INGV, AUTH, IST, KOERI, NIEP, NKUA, ROB, MSO, CRAAG)*

The Database of individual Seismogenic Sources, compiled by INGV (DISS, first released in 2000: DISS Working Group, 2007, http://www.ingv.it/DISS/) and its extension to S. Europe compiled within the EC-funded project FAUST and released in 2001-2002 (http://legacy.ingv.it/ ~roma/banche/catalogo_europeo/) will be expanded to the larger Euro-Mediterranean area. Common standards for the definition and characterization of active faults and active seismogenic sources will be adopted and consensus will be built by frequent exchanges and through regional meetings. Particular attention will be devoted to Quality Assurance and the characterization of uncertainties and of multiple interpretations, to ensure a homogenous input for use in hazard assessment. The European database of

active faults and seismogenic sources, to be used by all project partners and open to all users, will be compiled and maintained by INGV.

*Task 3.3. European crustal strain rates* (*INGV, NORSAR)*

We will incorporate geological, seismicity and GPS constraints to construct regional strain-rate models at regional scale for the Euro-Mediterranean region, following approaches applied also on a global scale (i.e., the Global Strain Rate Map Project on http://gsrm.unavco.org/intro/). The modeling will also include isostasy-driven strains and seismicity that are typical of northern Europe. The models allow to independently compare strain-rates on different time and spatial scales, and to estimate the aseismic portion of the crustal strains associated to plate tectonics. A set of models will be produced, in order to capture independent expert opinions, and will be used to define seismic source models in Task 3.4. The crustal strain rate models will be used to quantify earthquake activity rates and as a benchmark for the validation phase of the hazard modeling, to be conducted in the 3rd year of the project implementation.

*Task 3.4. Seismic Source Zones (GFZ, INGV, AUTH, NERC-BGS, IST, KOERI, NIEP, NKUA, NORSAR/IGC, ROB, MSO, CRAAG)*

The construction of a continent-wide model of seismic source zones will start from the existing national models of seismic sources and from the regional sets released by the SESAME/ESC project in 2000, with the compilation of a comprehensive database of all available models. The new regional integrated model will combine existing schemes and recent efforts with new knowledge and new descriptions of the earthquake potential, such as those deriving from fault and strain data. Attention will be given to geological and seismological input, rather than political constraints and national boundaries. Consensus will be built by comprehensive expert elicitation and participation of national experts. The new models will incorporate different expert opinions and model realizations, combined in a logic tree approach to obtain a realistic assessment of epistemic uncertainties.

*Task 3.5. Homogeneous determination of maximum magnitude (INGV, GFZ)*

This task will produce a homogeneous assessment (possibly multiple models) of the distribution of the expected Maximum Magnitude for earthquakes expected in various tectonic provinces of Europe, to serve as input for the computation and validation of seismic hazard. This goal will be achieved by combining input from earthquake catalogues, regional strain rates, knowledge of active faults and seismogenic zones, as well as the definition of the seismic source zones.

*Task 3.6. Earthquake activity rates (NORSAR-ICG, NERC-BGS, INGV, GFZ, SED-ETHZ)*

The assessment of expected rates of earthquake activity will be derived from the newly-compiled earthquake catalogue, incorporating the homogenous distributions of Mmax as well as constraints from geological and strain data. These latter data will serve also for an assessment of activity rates by balancing all available descriptions of the earthquake potential. Homogeneous procedures for de-clustering and catalogue completeness will be applied. Regional consensus will be achieved by elicitation of national specialists, as well as of non-European experts. Alternative models of activity rates will also be imported, presently derived using approaches complementary to seismic source zones, i.e. the smoothed-seismicity approach, within the NERIES JRA2 activity

**Role of participants**

INGV (3) will act as the general coordinator of WP3. It will organize periodic meetings and activate the regional experts. It will also be in charge of T3.1, T3.2, T3.3 and T3.5. It will contribute data to all other Tasks and participate in their activities. It will coordinate the

work with the other WPs.

AUTH (6) and NKUA (16) will contribute to T3.1 and T3.2 by supplying earthquake and seismogenic source data for Greece, and will co-lead the determination of seismic source zones (T3.4) for Eastern Mediterranean region.

KOERI (10) will contribute to T3.1 and T3.2 by supplying earthquake and seismogenic source data for Turkey, and will co-lead the determination of seismic source zones (T3.4) for the Eastern Mediterranean region.

NERC-BGS (14) will act as the co-leader of T3.6, will lead the collection of earthquake and tectonic data (T3.1, T3.2) for the North Sea, the Atlantic offshore and the polar areas (in cooperation with NORSAR/IGC) and will co-lead the determination of seismic source zones (T3.4) for that area. Given the nature of T3.6, NERC-BGS will also interact closely with the other tasks and the other regional coordinators.

NORSAR/IGC (17) will act as the co-leader of T3.6, will lead the collection of earthquake and tectonic data (T3.1, T3.2) for the Scandinavia and the polar areas (in cooperation with NERC-BGS) and will co-lead the determination of seismic source zones (T3.4) for that area. Given the nature of T3.6, NORSAR/IGC will also interact closely with the other tasks and the other regional coordinators.

ROB (18) will contribute to T3.1 and T3.2 by leading the collection of earthquake and seismogenic source data for central-western Europe, including France, Belgium, Holland, Switzerland, Austria and Germany, and will co-lead the determination of seismic source zones (T3.4) for that area with GFZ.

GFZ (2) will lead T3.4 and will be in charge of coordinating the determination of the seismic source zones. It will also contribute to T3.1 by supplying earthquake data and complete catalogues and will participate in the activities of T3.5 and T3.6.

IST (9) will contribute to T3.1 and T3.3 by supplying earthquake and seismogenic source data for the entire Iberian peninsula and the associated Mediterranean and Atlantic offshore, and will co-lead with CRAAG the determination of seismic source zones (T3.4) for Ibero-Maghreb area.

CRAAG (8) will contribute to T3.1 and T3.3 by supplying earthquake and seismogenic source data for the Maghreb region and the associated Mediterranean and Atlantic offshore, and will co-lead with IST the determination of seismic source zones (T3.4) for the Ibero-Maghreb area. It will be responsible to link to the on-going SDC IMPROVE Project.

NIEP (15) will contribute to T3.1 and T3.3 by supplying earthquake and seismogenic source data for the entire Balkan region, and will co-lead the determination of seismic source zones (T3.4) for that area.

MSO (13) will contribute to T3.1 and T3.3 by supplying earthquake and seismogenic source data for the entire Balkan region, and will co-lead the determination of seismic source zones (T3.4) for that area. It will be responsible to link to the on-going NATO SfP 983054 Balkan Seismic Hazard Project.

SED-ETHZ (1) will contribute to T3.1 and T3.3 by supplying earthquake and seismogenic source data for the Alpine region. It will also contribute to the determination of activity rates (3.6).

**Deliverables**

D3.1. Month 12. Compilation of existing regional and national seismic source zones

D3.2. Month 18. Updated European earthquake catalogue, with homogeneous magnitude calibration

D3.3. Month 18. Regional map of Mmax and associated database

D3.4. Month 24. Database of active faults and seismogenic sources

D3.5. Month 24. Reference strain rate models for the Euro-Mediterranean region

D3.6. Month 24. Logic tree of seismic source zones

D3.7. Month 24. Logic tree of earthquake activity rates

| **Work package number** | 4 | | **Start date or starting event:** | | | 1 | |
|---|---|---|---|---|---|---|---|
| **Work package title** | Strong ground motion modeling | | | | | | |
| **Activity Type** | RTD | | | | | | |
| **Participant number** | 4 | 12 | 7 | 6 | 10 | 1 | 13 |
| **Participant short name** | LGIT-UJF | METU | BRGM | AUTH | KOERI | SED-ETHZ | MSO |
| **Person-months per participant:** | 39 | 37 | 4 | 6 | 4 | 2 | 1 |

**Objectives**

To derive and to characterize ground shaking in Europe for specified rock-conditions, with the corresponding calibrations for application to different soil classes in Europe.

To coordinate the ground-motion specifications with the EC8 requirements.

To build a European-wide consensus on the understanding of expected strong ground motions

**Description of work** and role of participants

The core of WP4 is the definition of a reference European model of strong ground motions. The work will be conducted along three integrated levels:

– A restricted team of WP4 investigators (F. Cotton, LGIT-UJF; S. Akkar, METU; J. Douglas, BRGM; K. Pitilakis, AUTH) will coordinate the expert elicitation, carry out the data collection and model generation, and coordinate the technical specifications with the engineering requirements expressed in WP2.

– A core group of renowned European and global experts will assist the work of the WP4 investigator team, cooperating in the definition of the specifications and in the model selection. A preliminary list of confirmed experts for the core group includes: E. Faccioli (Politecnico di Milano), F. Scherbaum (Universität Potsdam), J. Bommer (Imperial College), H. Bungum (NORSAR/IGC), C. Oliveira (IST), N. Theodulidis (ITSAK), B. Glavatovic (MSO) and D. Fäh (SED-ETHZ).

– A wider consensus will be established through a European-wide meeting of experts from engineering seismology and earthquake engineers

The meetings of the core expert group are scheduled at months 1 (SHARE kick-off meeting), 13 and 21. The wider consensus meeting is scheduled at month 13 together with the expert core group, to provide feedback and validation. Travel resources to organize the expert workshops are allocated to the WP coordinator.

*Task 4.1. Extended ground-motion database (METU)*

SHARE will assemble an extended ground-motion database, to serve for model selection and adjustments, to test for regional patterns and for the evaluation of site amplification factors. The database will have two principle components:

1.An extended dataset for Europe and neighbouring regions, compiling the homogeneously

processed records from Ambraseys et al. (2005), Akkar and Bommer (2007), Bommer et al. (2007), the recently compiled Turkish strong-motion records and the updated Italian database; it is anticipated to have a total of 1200-1300 records with 3 □ Mw □ 7.6, covering a distance (Rjb) range up to 100 km;

2.Existing high-quality compilations recently assembled from SM records from Japan (KikNet, K-Net), Taiwan (SMART2), and the United States (NGA) to complement the European data in the higher magnitude range (M5+), for near-fault distances and low-period accelerations (4-20 seconds).

State-of-the-art SM records written at sites equipped with digital FBA equipment and with known velocity profiles (Vs30) will be privileged. The database will include all available site characterizations recently performed in many European countries (specially Turkey, Greece and Italy) as well as source parameters.

*Task 4.2. Rock model for peak ground motion and spectral values (LGIT-UJF, METU, BRGM)*

Existing ground motion models (recent European and NGA models, both global and regional equations, for relevant tectonic regimes) will be compiled and compared to convey a broad expert representation. If required by the experts, a new rock motion model will be derived. Residuals analysis, estimation of minimum-misfit stochastic models from empirical ground-motion prediction equation and expert discussions will then help to define mean values and uncertainty bounds for the Vs30 of each of the selected attenuation model. Selected models will be adjusted for common magnitude, distance, style-of-faulting, horizontal component definition, and common rock site Vs30, and will then be combined with appropriate weighting in a logic tree approach (both for the median and aleatory variability), to cover a broad spectrum of expert opinions. The composite model will express ground motions in a number of spectral parameters (SA, SV, SD), covering frequencies of engineering interests and including long-periods (4-10 seconds) as required in displacement-based design formulation.

The ground-motion rock model will be evaluated systematically; focusing on two specific effects:

1.We will explore how strong-motion data from Europe are compatible with other active crustal regions and NGA models, and we will characterize regional variations, if any, with specific focus on events with smaller magnitudes (M<5), to test scaling issues in the compatibility of small-magnitude records from Europe with large-magnitude global patterns. The obtained scaling will then be evaluated for possible consequence on the low magnitude calibrations (ML-Mw conversion) and on the functional form to be used in predictive ground-motion models to account for an extended magnitude range.

2.We will calibrate variations for known regional effects (e.g., the Vrancea region, subduction zones around the Aegean Sea, oceanic crust in Portugal etc.) using regional specific data included in the database (Task 4.1). Host-to-target adjustments will be performed, including regional weak motion data and estimates of minimum-misfit stochastic model. Regional effects will also be considered through the use of ground-motion models specific to particular regions.

*Task 4.3. Site amplification factors (LGIT-UJF, METU, AUTH)*

Goal of this task is to derive appropriate calibrations for the application of generic ground-motion prediction equations (GMPE) to specific soil and rock conditions, along two directions:

1.Keeping the EC8 site classification criteria unchanged and proposing the corresponding

"optimal" spectral shapes and/or amplification factors

2.Exploring new tracks for new site classification, and proposing site amplification factors accordingly

The work will first consist in compiling the site coefficients indicated in recent GMPE, to compare and discuss them in view of the quality – often very diverse – of the background geotechnical information.

In a second stage, the strong motion data base built in Task 4.1 will be used to test the consistency of various site coefficients with the available European data, using the whole database, for which the site geotechnical information may be of varying quality, or subsets of data for which the site conditions are very well known and quantitative values of Vs30 can be considered reliable.

The present practice is to use Vs30 for site classifications and many new GMPE are derived on this basis, including NGA. This task will explore the practical applicability of new promising classification criteria, based on the site fundamental frequency f0, together with some information on the shallow velocity (average velocity over the top 5 to 10 meters). This exploration will include the selection of promising, recently proposed classification schemes, testing them on the SHARE strong motion dataset, derivation of the corresponding site amplification factors on the basis of world best data sets and consistency with European data set, and statistical tests to ensure the consistency of this new kind of site amplification factors with the traditional Vs30 values.

Concerning the quantification of site effects in the perspective of code application in the near future, we will then test if the use of discrete classes (ground type A, B, etc.) could be replaced by a continuous, smooth description of type f (Vs30), with the aim of avoiding artificial and unjustifiable jumps in amplification coefficients at the limits between adjacent ground types, and bypassing the problem of introducing different types of reference rocks.

Finally, we will use a literature survey and the strong motion dataset to investigate the issue of soil non-linear behaviours: the dependency of site amplification factors on ground motion level (characterized by PGA, or PGV, or some strain level) will be carefully looked at, with a special attention to the significance level of possible differences between low and high levels.

*Task 4.4. Europe-wide proxies to site conditions (LGIT-UJF, SED-ETHZ)*

An increasing number of applications require regional hazard maps including site effects. As site conditions are usually not available with the appropriate density and coverage, a growing attention is paid to "proxies" to site conditions and Vs30 velocities, such as surface topography slope (see for example the Global Vs30 model of Wald and Allen on http://earthquake.usgs.gov/research/hazmaps/interactive/vs30/). We will perform statistical tests to check the relevance of such proxies for application at the whole European scale and their compatibility with the proposed Vs30 classification schemes (Task 4.3).

*Task 4.5. Earthquake scenario tools (KOERI)*

We will import the tools developed in the EC projects NERIES and SAFER, to generate shaking scenarios for individual events and ensure their compatibility with the ground-motion models developed in Tasks 4.2-4.3.

*Task 4.6. Alternative ground motion parameters (LGIT-UJF, METU)*

Using the updated European database we will derive vector predictions for strong-motion duration (SMD), Arias intensity (AI), central frequency (Fc), and the frequency bandwidth (Fb), to serve as input for the generation of realistic non-stationary acceleration time

histories. The empirical equations will be derived for various soil classes compatible with Tasks 4.2-4.3.

*Task 4.7. Site effects in Alpine valleys (LGIT-UJF, SED-ETHZ)*

Test and validate schemes to capture large ground motion amplifications observed in specific environments – i.e. near fault effects, 3D basin effects in Alpine valleys – not captured by standard approaches and soil classifications. We will test and compare different approaches, including simplified response functions for deep sedimentary valleys as well as advanced numerical modeling developed to simulate time histories in such local and complex settings, with the aim to test how to include seismological simulations within PSHA studies. Specifies areas (e.g., Wallis, Grenoble basin) will be chosen in order to test and validate these new ideas.

**Role of participants**

LGIT-UJF (4) will be the general coordinator of WP4. It will organize periodic meetings and lead the expert elicitation. It will be involved in or lead most of the WP4 Tasks. Together with METU, it will be responsible for all the computations in WP4.

METU (12) will lead the compilation of the strong-motion database (4.1) and will be involved in most other tasks of WP4. Together with LGIT-UJF, it will be responsible for all the computations in WP4.

AUTH (6) will contribute to the calibration of soil response classifications (4.2 and 4.3) and will be primarily responsible to ensure the interface with the engineering requirements in WP2.

KOERI (10) will be responsible to transfer to SHARE the scenario modeling tools developed in the EC projects NERIES and SAFER, and to ensure their compatibility (4.5)

SED-ETHZ (1) will participate in task 4.7 with the simulation for the Wallis test area and in task 4.4 for the calibration of empirical corrections between Vs30 and intensity site corrections.

BRGM (7) will participate in task 4.2 for the development of the tools and methodology to undertake host-to-target adjustments for the selected regions.

**Deliverables**

D4.1. Month 12. Updated strong-ground motion database

D4.2. Month 18. Regionally adjusted Ground Motion Predictions Equations (GMPE) for Europe

D4.3. Month 18. New site classification scheme and associated site amplification factors

D4.4. Month 18. European Vs30 map derived from surface topography slope and site calibrations

D4.5. Month 24. Vector predictions for strong-motion duration (SMD), Arias intensity (AI), central frequency (Fc) and frequency bandwidth (Fb)

| **Work package number** | 5 | **Start date or starting event:** | | | 1 |
|---|---|---|---|---|---|
| **Work package title** | Seismic hazard assessment | | | | |
| **Activity Type** | RTD | | | | |
| **Participant number** | 2 | 1 | 5 | 3 | 4 |
| **Participant short name** | GFZ | SED-ETHZ | UPAV | INGV | LGIT-UJF |
| **Person-months per participant:** | 24 | 9 | 2 | 2 | 2 |

**Objectives**

To set up a hazard control group in charge of checking all steps of the hazard assessment

To set up quality control procedures and hazard assessment specifications allowing full validation of the hazard assessment procedures and results

To assess seismic hazard according to WP2 engineering specifications, conduct validation tests and elicit community feedback

**Description of work** and role of participants

*Task 5.1. Quality control procedures and input-output specifications (GFZ, SED-ETHZ)*

We will implement QA procedures for all steps in the assessment of the inputs for hazard (WP3-4) as well as of the output specifications (WP5) and overall quality control procedures to ensure that all hazard computations are benchmarked, can be fully reproduced in all steps, and can be correctly validated. We will define specifications for interfaces that accept input from WP2, WP3, and WP4 for hazard computation and interfaces that produce output for the engineering applications described in WP2. This task will be carried out jointly with WP6.

*Task 5.2. Logic tree design (GFZ, SED-ETHZ, UPAV, INGV, LGIT-UJF)*

We will build the complete logic tree to be used in the computation of seismic hazard with particular attention devoted to ensure that all uncertainties are correctly assessed, to avoid unrealistically low estimates as well as double-counting issues.

*Task 5.3. Computation of synthetic earthquake catalogues (GFZ, SED-ETHZ)*

As an intermediate product for both PSHA as well as deterministic risk scenario computations, we will compute synthetic earthquake catalogues corresponding to the activity-rate and Mmax models produced in WP3.

*Task 5.4. Computation of seismic hazard (SED-ETHZ, GFZ)*

We will compute seismic hazard using the infrastructure built in WP6 at SED-ETHZ. The hazard computations will be performed on the basis of the inputs of WP3-4 and the engineering output specifications provided by WP2. The assessment will take place in two phases; in the first phase (months 25-27) we will produce the first complete round of regional mapping; after a phase of validation and community feedback (months 28-30), final hazard products will be produced (months 31-32). Both the intermediate and the final hazards will be used in WP2 for engineering applications and scenario modeling. Seismic

hazard will be expressed in a variety of ground-shaking parameters (SA, SD, PGV) and for return periods up to 10,000 years ($10^{-4}$ yearly exceedance probability). The hazard will be de-aggregated with respect to magnitude and distance, to provide direct input for engineering applications.

*Task 5.5. Validation of seismic hazard results (GFZ, SED-ETHZ, UPAV, INGV, LGIT-UJF)*

The hazard results will be subject to a stringent validation phase (months 25-32), conducted according to various complementary criteria and sanity checks:

– Validation of site-intensity histories at sample locations

– Validation of ground-shaking parameters against observed distributions at sample locations

– Validation of the regional maps against existing national products

– Validation of cumulative seismic strains from synthetic catalogues, compared with geodetic and geological evidence

– Validation of the main hazard contributors obtained from the de-aggregation (plausibility of depth and magnitude range)

– Validation of the overall compatibility of results (such as checking the correspondence of the adopted ground-motion models to the main hazard contributors obtained in the de-aggregation)

*Task 5.6. Community feedback on seismic hazard results (GFZ, SED-ETHZ, UPAV, INGV, LGIT-UJF)*

The intermediate hazard will be presented for feedback to the wider communities who contributed to the preparation of all inputs (WP3-4) and to the engineering community responsible to draw the requirement specification documents (WP2). The feedback phase (months 28-30) will provide input for the hazard refinement

**Role of participants**

GFZ (2) will coordinate WP5 and will be involved in all its tasks. It will prepare the input earthquake model to be implemented in the SHA Portal of WP6.

SED-ETHZ (1) will be involved in all tasks.

UPAV (5) will be involved in T5.2, T5.5 and T5.6 with the main focus on providing feedback for validation of the seismic hazard results.

INGV (3) will be involved in T5.2, T5.5 and T5.6 with the main focus on providing feedback for validation of the seismic hazard results.

LGIT-UJF (4) will be involved in T5.2, T5.5 and T5.6 with the main focus on providing feedback for validation of the seismic hazard results.

**Deliverables**

D5.1. Month 12. Input specifications for seismic hazard computation

D5.2. Month 14. Structure of the logic tree to be used in seismic hazard computation

D5.3. Month 25. Suite of synthetic earthquake catalogues, computed according to different branches of the hazard logic tree

D5.4. Month 27. First-round regional seismic hazard assessment including de-aggregation and validation

D5.5. Month 32. Final seismic hazard assessment including de-aggregation

| **Work package number** | 6 | **Start date or starting event:** | | 1 | | |
|---|---|---|---|---|---|---|
| **Work package title** | Computational infrastructure | | | | | |
| **Activity Type** | RTD | | | | | |
| **Participant number** | 1 | 7 | 3 | 5 | | |
| **Participant short name** | SED-ETHZ | BRGM | INGV | UPAV | | |
| **Person-months per participant:** | 30 | 9 | 1 | 1 | | |

**Objectives**

To plan, construct and validate the core computing infrastructure (both hardware and software) to enable uniform, quality-controlled assessments of seismic hazard across Europe and the distribution of those assessments to a variety of end-users, including the general public, policymakers, scientists, and practicing engineers.

To install a flexible Web service-oriented architecture to connect databases of seismic hazard information with a robust computational engine for seismic hazard assessments, and a set of Web-based systems to control the computational engine and to provide results from the seismic hazard calculations.

To link the SHARE Portal for hazard data, tools and products to the Portal presently developed for the Euro-Mediterranean Seismological Survey within the EC NERIES project

**Description of work** and role of participants

*Task 6.1: Databases (SED-ETHZ)*

This task will produce relational databases to contain the input data required for the seismic hazard assessments in WP5. There will be four primary databases, produced by the other Work Packages and contributed to WP6 for inclusion in the computational database:

– Seismic source zones, maximum magnitudes and earthquake activity rates (WP3)

– Ground-motion models and site effects (WP4)

– Synthetic earthquake catalogues (WP5)

– Logic trees governing hazard estimates (WP3)

All the aggregated databases required for the Europe-wide hazard assessment will be maintained and available on the SHARE facility at SED-ETHZ. All primary input datasets (such as the individual catalogues used to assemble the reference European catalogue) will be available at the institutes that generated them, and a comprehensive meta-database will be maintained by SHARE to allow users to access the primary data.

*Task 6.2: Web service-oriented architecture (BRGM, SED-ETHZ)*

The databases will be connected to the SHA computational engine (Task 6.3) and the SHARE Portal (Task 6.4) via a Web service-oriented architecture. This structure will be based on tools that access the databases without imposing a rigid structure on the interconnected databases, offering several distinct advantages. It will

– Provide the ability to grow as scientific and engineering needs dictate changes in the future;

– Enhance security, as access to read database contents is separated formally from the ability to modify database contents; and

– Allow SHARE to leverage prior work by FP6 NERIES, the FP6 ORCHESTRA project, the QuakeML project at SED-ETHZ and SCEC, and related projects, to rapidly build a flexible framework connecting data sources with computational and access tools.

*Task 6.3: SHA Computational Engine (SED-ETHZ, BRGM)*

We will implement a flexible, robust computational engine for seismic hazard calculations. This engine will be able to ingest heterogeneous earthquake activity data via the Web service framework, apply any of multiple seismic attenuation measures to those data to facilitate easy cross-validation, and generate multiple products, including hazard maps, event shaking scenario maps, and site-specific hazard curves. It should also be adaptable as future models and outputs are defined.

We will base our engine on the OpenSHA framework, developed in the United States. OpenSHA is free, open-source software that is inherently designed to handle diverse data sources and multiple model types via an object-oriented, modular framework. It is readily extensible as new shaking models such as European Next Generation Attenuation and physics-based full-waveform simulations, and desired outputs, such as scenario shakemaps, are defined in the future. OpenSHA is thus ideally suited for this effort.

We will implement the current OpenSHA framework on a computing cluster at ETH-Zurich that will be available to all project partners, while developing software tools necessary to extend OpenSHA to European applications. This will include modules to incorporate the ground motion models and logic trees developed under WP3 and WP4 and provide outputs required by the engineering community via WP2. We will work together with the OpenSHA community to develop the next generation standards for open software for seismic hazard analysis. All software modules will be made available to the community from the project Web site.

The whole infrastructure will remain active beyond the completion of SHARE, as a regional center within the framework of the Global Earthquake Model. One duty of the European GEM center will be to twin with the development of similar initiatives in developing countries to raise global standards.

*Task 6.4: SHARE Portal (SED-ETHZ, BRGM, INGV, UPAV)*

We will develop a Web-based Portal as the central access point for the project. Such portals are modular, highly scalable, extensible, and flexible as needs develop over time; can be easily customized to provide the general public, scientists and engineers, policymakers, and other users with appropriate data and access given their different roles; and can be used to interconnect with other relevant projects via Web services. Other large Earth science projects, including NERIES, GEON, and EarthScope are developing portals of the same class, and SHARE will leverage existing knowledge to speed development and ensure connectivity. In particular, the SHARE Portal will be built as a major block of the European–Mediterranean Seismological Service Portal presently built under NERIES. The SHARE Portal will provide single-point access to all data sets, model definitions, data schema, reports, and other project products via any standard Web browser without the user needing to know where the products themselves are held.

The portal will be built within the SHA computational engine under WP6, to enable the functionality required to extract specific user-defined products, whereas all the interfaces for a comprehensive dissemination strategy will be built in WP7.

**Role of participants**

SED-ETHZ (1) will coordinate WP6 and will lead all its activities.

BRGM (7) will be involved in Tasks 6.2 to 6.4, providing expertise in Web service and Portal design and modules to ingest data using Web services and to ensure proper incorporation of data from WP4.

INGV (3) and UPAV (5) will provide coordination in order to ensure WP6 products meet the requirements of the dissemination efforts in WP7.

**Deliverables**

D6.1. Month 6. OpenSHA design specifications document

D6.2. Month 6. Portal design specifications document

D6.3. Month 12. Web service-oriented architecture providing access to all databases

D6.4. Month 18. Initial OpenSHA engine

D6.5. Month 18. Initial Portal implementation

D6.6. Month 24. Databases of seismogenic zones, Mmax, earthquake activity rates, ground-motion attenuation relations, and associated logic trees

D6.7. Month 24. Operational SHARE Portal

D6.8. Month 24. Validated OpenSHA engine

| **Work package number** | 7 | **Start date or starting event:** | | 1 | | |
|---|---|---|---|---|---|---|
| **Work package title** | Dissemination | | | | | |
| **Activity Type** | OTHER | | | | | |
| **Participant number** | 5 | 3 | 1 | | | | |
| **Participant short name** | UPAV | INGV | SED-ETHZ | | | | |
| **Person-months per participant:** | 6 | 4 | 3 | | | | |

**Objectives**

Disseminate information about SHARE, its objectives, the approaches and results to the general scientific community
Ensure European-wide visibility and dissemination of the project outcomes to policymakers and regulating/standardisation bodies
Establish two-way communication channels with the aforementioned stakeholders and organise needed liaison activities
Create synergies with other relevant EC-funded projects such as LESSLOSS, NERIES and SAFER
Promote and carry out general public awareness initiatives
Publish a new map of seismic hazard of the Euro-Mediterranean region

**Description of work** and role of participants

*Task 7.1. Collaboration in dissemination e-platform development (UPAV, INGV)*
SHARE will create under WP6 a Portal to disseminate seismic hazard results. WP7 will develop specifications and web interfaces for how this tool should facilitate dissemination efforts to a heterogeneous audience comprising scientists, policymakers and practitioners, and it will provide content to be presented on the Portal. These functions of the Portal will be partially based on the eRiskZone (www.eriskzone.net) tools developed under by Geodeco, SpA and expanded for SHARE under a subcontract from UPAV. The Portal will also provide access to the SHARE hazard model and products through an interactive mapping system based partially on the INGV Interactive Seismic Hazard Maps (http://esse1-gis.mi.ingv.it/s1_en.php).

As example of the portal functionalities, users will be able to select a given location and obtain hazard in terms of damped response spectrum but also acceleration time-histories whose elastic response spectra match the design spectrum at the site of interest (i.e., scaled for hazard level, site class and other parameters). The Portal will also provide expert users Web access to the SHARE computational engine to extract user-specific hazard products; for example, such a user could specify a map location, rock type, earthquake rate model, and time window, and generate the applicable hazard curves.

*Task 7.2. Scientific external dissemination (ALL)*
SHARE project partners will disseminate to the scientific community information on and results from the project via presentations at appropriate national and international meetings and peer-reviewed publications.
We also envision taking the following approaches to spread information to scientific users:
– Publication of a periodic electronic newsletter presenting the on-goings of the project
– Presentation of the project and approved results in the public area of the SHARE web-portal

– Organization of special sessions of International Congresses dedicated to seismic hazard and risk assessment (e.g. European Geophysical Union Meeting 2009, European Seismological Commission Meeting 2009)
– Establishment of specific Working Groups within the European Seismological Commission formed by the WP3-4-5 participants, in order to embed SHARE in the larger scientific and technical community
– Establish the SHARE hazard computational facility as one of the regional nodes of the Global Earthquake Model program, initiated by the OECD, offering the possibility to partner with developing countries and to transfer the SHARE technologies

*Task 7.3. Outreach to policymakers and stakeholders (ALL)*
One of SHARE's principal goals is to produce methods and products that be readily employed in the updating of building codes such as Eurocode 8. In order to ensure our products may be effectively used by policymakers, industry, and related groups, we anticipate:
– Inviting policymakers and stakeholders to take part in plenary and/or WP meetings
– Production of tailored documentation (e.g. hard-copy brochures or reports) aimed at communicating the results of the projects in a way that is consistent with such target audience
– Organisation of targeted workshops once again aimed at increasing the awareness of these specific end-users to the pertinence and value of achieved outcomes

*Task 7.4. Synergies with other related projects and initiatives (UPAV, SED-ETHZ )*
We will interact with a number of other national and international projects, such as NERIES, to share information and build on existing expertise. For example, a number of SHARE partners (including the coordinator of the project and the leader of this work package) were or are participants in large European research projects such as NERIES, LESSLOSS, SAFER, something that will assist significantly the transfer of knowledge (from already completed projects) and the triggering of collaboration initiatives (with projects still running). Duplication or overlapping of efforts and results will be avoided, thus ensuing optimum use of available human and economic resources. The overall goal remains to stimulate the growth of a wide technical hazard community in Europe, beyond national or project boundaries.

*Task 7.5. Promoting public awareness (UPAV, INGV)*
It is important to ensure that the general public is not only aware of the level of seismic hazard to which it may be exposed to, but also of the commitment of scientific/professional communities, policymaking bodies, European Commission, etc, in mitigating earthquake-related risks. As such, advantage will be taken from not only the accumulated experience in such type of public awareness raising activities (e.g. preparation of material adequate for distribution in schools, organisations of public visits to research centres, organisation of press conferences, etc) but also of the existing association of the coordinator of this work package with a media communications venture (Segni & Suoni) specialised in the feeding of press releases to printed, audio and audiovisual media organisations.

*Task 7.6. Euro-Mediterranean seismic hazard map (SED-ETHZ)*
A highly-visible product of SHARE will be a new map of seismic hazard for the Euro-Mediterranean territory, for distribution to public offices, schools, education institutions and the interested public. In past projects (GSHAP and SESAME/ESC), the produced maps became very popular products, distributed worldwide in many thousands of copies. We expect the same success for the SHARE maps.

**Role of participants**

Effective dissemination is a declared objective of SHARE, and various activities will be organized to this end, as described also in Section 3.2.1. All the SHARE participants will be actively involved in defining the overall strategy and in the dissemination of results and

products, bringing the experience developed in years of specific divulgation activities within their national programs. In particular, all participants will be involved in Task 7.2. Scientific external dissemination, Task 7.3. Outreach to policymakers and stakeholders, and Task 7.5. Promoting public awareness. Additionally, in WP7 three SHARE partners will engage to develop specific tools and initiatives for effective dissemination.

UPAV (5) will coordinate WP7 and lead all its tasks. It will also manage a sub-contract to Geodeco SpA, responsible to develop specific interfaces for the SHARE web portal, devoted to distribution of and access to the SHARE products and applications.

INGV (4) will participate in the Tasks 7.2, 7.3, 7.4 and 7.6, contributing to the overall strategy and implementation of the SHARE dissemination strategy, and bringing the experience developed in years of specific divulgation applications developed for the Italian Department of Civil Protection.

SED-ETHZ (1) will participate in the Tasks 7.1, 7.3, 7.4 and 7.5, contributing to the overall strategy and implementation of the SHARE dissemination strategy, and bringing the experience developed in years of specific divulgation applications as part of its service activities for the Swiss government. It will be in charge of the production and printing of the new European map of seismic hazard.

**Deliverables**
D7.1(a-c). Months 14, 25, 36. Dissemination e-newsletter
D7.2(a-b). Months 25, 36. Brochures for policymakers & stakeholders
D7.3. Month 36. Euro-Mediterranean seismic hazard map

### *B.1.3.6 Efforts for the full duration of the project*

**Project effort form 1**

Project number: SHARE - 226967

| Participant no./short name | WP1 | WP2 | WP3 | WP4 | WP5 | WP6 | WP7 | Total per beneficiary |
|---|---|---|---|---|---|---|---|---|
| 1 / SED-ETHZ | **36** | 2 | 2 | 2 | 9 | **30** | 3 | **84** |
| 2 / GFZ | | | 22 | | **24** | | | **46** |
| 3 / INGV | | | **52** | | 2 | 1 | 4 | **59** |
| 4 / LGIT-UJF | | 2 | | **39** | 2 | | | **43** |
| 5 / UPAV | | **52** | | | 2 | 1 | **6** | **61** |
| 6 / AUTH | | 12 | 7 | 6 | | | | **25** |
| 7 / BRGM | | | | 4 | | 9 | | **13** |
| 8 / CRAAG | | | 11 | | | | | **11** |
| 9 / IST | | | 12 | | | | | **12** |
| 10 / KOERI | | 4 | 10 | 4 | | | | **18** |
| 11 / LNEC | | 12 | | | | | | **12** |
| 12 / METU | | | | 37 | | | | **37** |
| 13 / MSO | | 1 | 5 | 1 | | | | **7** |
| 14 / NERC-BGS | | | 13 | | | | | **13** |
| 15 / NIEP | | | 15 | | | | | **15** |
| 16 / NKUA | | | 8 | | | | | **8** |
| 17 / NORSAR-ICG | | | 14 | | | | | **14** |
| 18 / ROB | | | 7 | | | | | **7** |
| **Total** | **36** | **85** | **178** | **93** | **39** | **41** | **13** | **485** |

## Project effort Form 2

Project number : SHARE 226967

| Activity Type | SED-ETHZ | GFZ | INGV | LGIT-UJF | UPAV | AUTH | BRGM | CRAAG | IST | KOERI | LNEC | METU | MSO | NERC-BGS | NIEP | NKUA | NORSAR-ICG | ROB | **TOTAL ACTIVITIES** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RTD activities | | | | | | | | | | | | | | | | | | | |
| WP 2 | 2 | | | 2 | 52 | 12 | | | | 4 | 12 | | 1 | | | | | | **85** |
| WP 3 | 2 | 22 | 52 | | | 7 | | 11 | 12 | 10 | | | 5 | 13 | 15 | 8 | 14 | 7 | **178** |
| WP 4 | 2 | | | 39 | | 6 | 4 | | | 4 | | 37 | 1 | | | | | | **93** |
| WP 5 | 9 | 24 | 2 | 2 | 2 | | | | | | | | | | | | | | **39** |
| WP 6 | 30 | | 1 | | 1 | | 9 | | | | | | | | | | | | **41** |
| **Total** | **45** | **46** | **55** | **43** | **55** | **25** | **13** | **11** | **12** | **18** | **12** | **37** | **7** | **13** | **15** | **8** | **14** | **7** | **436** |
| Demomonstration activities | | | | | | | | | | | | | | | | | | | |
| **Total** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| Cons. managment activities | | | | | | | | | | | | | | | | | | | |
| WP 1 | 36 | | | | | | | | | | | | | | | | | | **36** |
| **Total** | **36** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **36** |
| Other activities | | | | | | | | | | | | | | | | | | | |
| WP 7 | 3 | | 4 | | 6 | | | | | | | | | | | | | | **13** |
| **Total** | **3** | **0** | **4** | **0** | **6** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **13** |
| **TOTAL BENEFICIARIES** | **84** | **46** | **59** | **43** | **61** | **25** | **13** | **11** | **12** | **18** | **12** | **37** | **7** | **13** | **15** | **8** | **14** | **7** | **485** |

### *B.1.3.7 List of milestones and planning of reviews*

**List and schedule of milestones**

| Milestone no. | Milestone name | WPs no's. | Lead beneficiary | Delivery date from Annex I [1] | *Comments* |
|---|---|---|---|---|---|
| 1 | Seismic hazard definitions for structural design applications | 2, 4 | UPAV | 6 | Report |
| 2 | Design specifications for OpenSHA engine and Portal | 6 | SED-ETHZ | 6 | Reports |
| 3 | Strong-motion database | 4 | LGIT-UJF | 12 | Database |
| 4 | Delivery of all input earthquake data, catalogues and models | 3, 4, 5 | INGV | 18 | Reports, databases |
| 5 | Delivery of European ground-motion models and site effect calibrations | 4, 5 | INGV | 18 | Reports, databases |
| 6 | Initial OpenSHA and Portal implemented | 6, 5 | SED-ETHZ | 18 | E-infrastructure |
| 7 | All databases implemented on OpenSHA engine | 6, 3, 4, 5 | SED-ETHZ | 24 | Report, databases |
| 8 | SHARE Portal operational | 6 | SED-ETHZ | 24 | E-infrastructure |
| 9 | First-round seismic hazard assessment | 5, 6 | GFZ | 27 | Report, databases |
| 10 | Community feedback completed | 5, 2, 3, 4 | GFZ | 30 | Reports |
| 11 | Final seismic hazard assessment | 5, 6 | SED-ETHZ | 32 | Report, databases, maps |
| 12 | Seismic risk/loss scenarios for European sites | 2, 5 | UPAV | 36 | Report |
| 13 | Engineering evaluations and recommendations for EC8 application | 2, 5 | UPAV | 36 | Report |

## Tentative schedule of project reviews

| Review no. | Tentative timing, i.e. after month X = end of a reporting period | *planned venue of review* | *Comments , if any* |
|---|---|---|---|
| | | | |
| **1** | After project month: 12 | **Meeting** | **Report from scientific advisory board** |
| **2** | After project month: 24 | **Meeting** | **Report from scientific advisory board** |
| **3** | After project month: 36 | **Meeting** | **Report from scientific advisory board** |

# B.2 Implementation

## *B.2.1 Management structure and procedures*

The SHARE Consortium includes 18 participants from 13 countries of the Euro-Mediterranean area, European seismological organizations and universities involved in various aspects of seismic hazard assessment, with activities spreading among 6 integrated work packages. The definition of the duties, responsibilities and composition of the different bodies is given here together with the proposed management structure (Figure 2). The Consortium Agreement defines in details the interaction between these bodies.

***SHARE Consortium***

The Consortium General Assembly, composed by one representative for each consortium member, will be held yearly to bring together the whole consortium, the Management Committee and the Scientific Advisory Board. The General Assembly will meet first at the project kick-off meeting, to finalize details of the project work plan and work breakdown structure, and then annually to discuss project progress and status. The Consortium will establish a Consortium Agreement, signed by all participants, including all financial, administrative and coordination provisions not covered by the Contract, and regulating the inter-relation between the different activities.

***Coordinator***

The Project Coordinator is the single contact person for the project towards the Commission and the outside. He is responsible for the execution and management of the project, the reporting of progress to the Commission and to the Consortium, and for the liaisons among the SHARE governing bodies. **Prof. Domenico GIARDINI** will coordinate SHARE.

***Scientific Advisory Board (SAB)***

The Scientific Advisory Board (SAB) monitors the progress of the project and advises the Management Committee and the Consortium on all issues of general scientific policy. It represents the interests of the wider scientific and engineering community and of key stakeholders in different sectors of the society, not covered by the Consortium. Its 4 members include key research figures in seismology and earthquake engineering. The composition of the Board will be finalized upon completion of the negotiation. The SAB will meet annually with the MC and the General Assembly to review project plans, progress, and results.

***Program Manager***

The SHARE Program Manager is in charge of all operational and management aspects of the project. **Dr. Jochen WOESSNER** will be the SHARE Program Manager.

***Management Committee (MC)***

The SHARE activities will be led by the Management Committee (MC), in charge for the overall management of the work packages and of the whole project, the development of the project, the information flow within the project and for reporting to the EC and the consortium. It may propose major revisions of the project to the EC and Consortium, if new solutions are required to reach the general objectives of the project. The MC will consist of the Project Coordinator and Manager and of the leaders of the work packages (representing UPAV, SED-ETHZ, GFZ, INGV and LGIT-UJF).

The ensure proper ownership of the project's approach, tools and results, the MC will be in charge of WP5, where all specifications will be approved and all activities in seismic hazard assessment will be validated. The MC holds quarterly teleconferences for project coordination, and meets in person for the yearly review in occasion of the Consortium General Assembly, and holds ad-hoc meetings as necessary, called by the Director or by two or more MC members. The functioning of the MC is detailed in the Consortium Agreement.

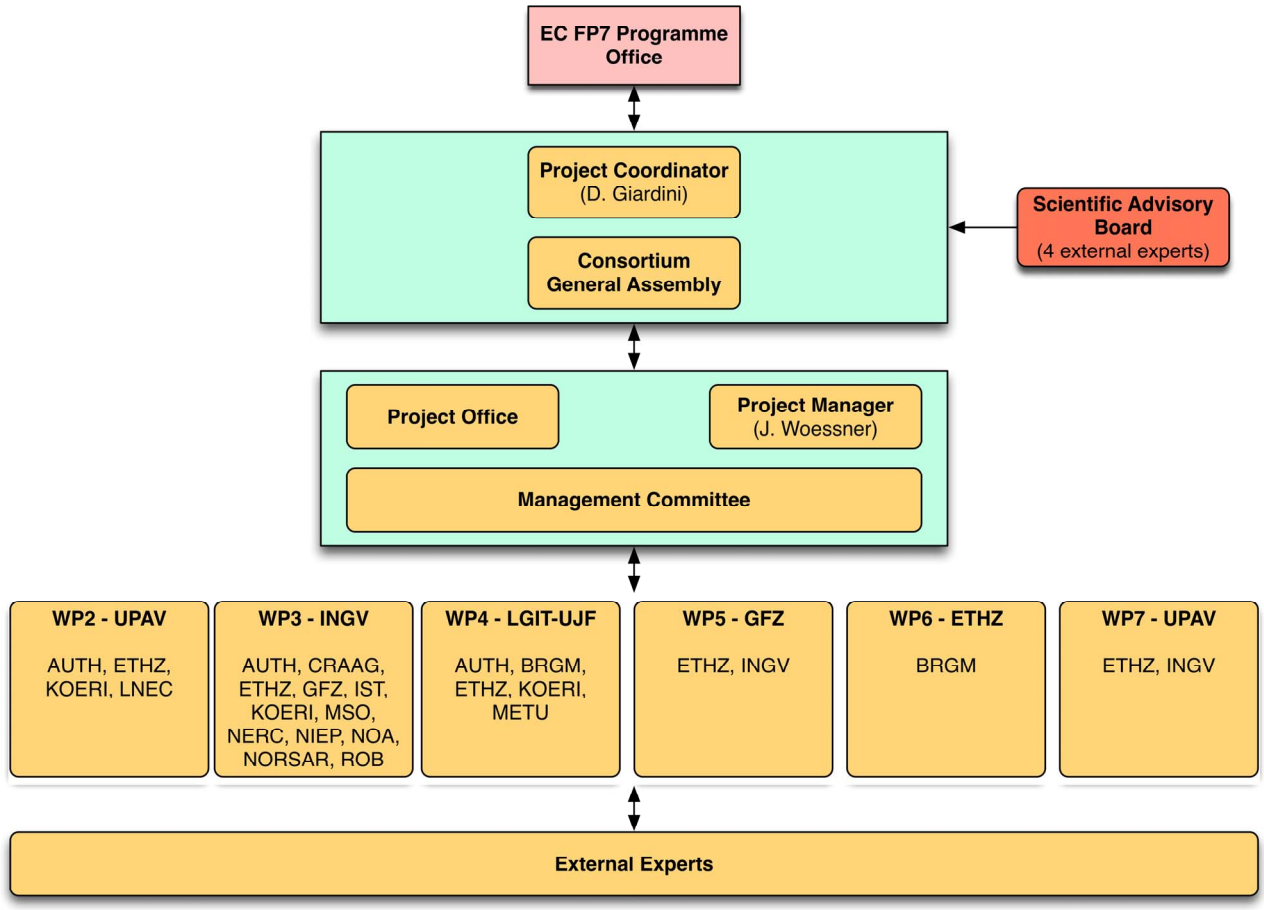



**Figure 2:** Proposed SHARE management structure. The Project Coordinator and Consortium General Assembly provide governance for the project, with advice from the Scientific Advisory Board, and the Project Coordinator reports to the EC programme office. The Project Manager oversees operational and routine management aspects of the project, in collaboration with the Management Committee and assisted by the Project Office. Work package leaders oversee the scientific, engineering, and technical aspects of the SHARE project in their work packages, with advice from external experts as appropriate.

### *Project Office (PO)*

The management committee is supported by the SHARE Project Office (PO), which will execute the daily management tasks like the financial and contractual issues, the management of budget and time, the monitoring and execution of quality checks, the reporting to the EC and the consortium, the communication and flow of information within the project and the maintenance of the project website. The PO will be located at SED-ETHZ and will provide administrative (15%) and financial (15%) assistance to the Project Manager and Coordinator.

### *Work Package Leaders*

Work package leaders manage their WP and are fully responsible for the quality and timely delivery of the deliverables of the WP. They also work together via the MC and other informal methods to ensure interconnectivity with other work packages. The activity leaders confirm their progress on all issues at least quarterly, or based on needs, to the Project Office.

### *B.2.1.1 Management aspects*

The management is focused on seven aspects: organization, time, budget, quality, process, risks, and communication. The SHARE organization has been commented in the previous section, here we comments on the other aspects.

***Management of time and budget***

Each WP leader will draft a detailed schedule for all activities and quality procedures will report quarterly to the project coordinator and manager. The frequency and content of reporting to the EC will be defined in the contract.

***Management of quality***

To control the quality of the project several tools will be implemented. For each activity in the working plan a quality procedure will be defined stating the quality requirements of the deliverables, the activity specific risks and the remedial actions, the monitoring of the work, bottlenecks and risks by the WP leader, and the reviewer and the reviewing procedure for each deliverable and milestone (where appropriate).

SHARE will implement mechanisms to acquire evidence that the implementation is measurably beneficial and successful with respect to the identified expected impacts. Following standards widely used in industry, we propose to identify and monitor four performance measures: input, output, outcome and impact indicators. Particularly important are the impact indicators, specified under section (3).

***Management of process***

SHARE will adopt procedures to ensure quality across all aspects of the project, focusing on four major targets:

– Implement a consistent set of working guidelines throughout the whole project

– Minimize the possibility of undetected errors

– Guarantee the reproducibility and traceability of all project decisions and results

– Ensure appropriate validation of tools and results

To achieve this level of QA, the SHARE implementation will subject the following elements to formalized QA procedures:

– Management of project documents

– Management of quality of input data

– Acceptance of input data into the reference project database

– Expert elicitation and role of the Technical Integrators in WP5, consistent with a SSHAC Level-3 procedure

– Conversion of the logic tree models into hazard computation input

– Software verification and benchmarking

– Output requirement specifications (from WP2)

– Input specification files for hazard computations

– Hazard computations

A set of specific tools will be introduced on the project web portal to facilitate quality assurance.

***Management of risks***

General and specific risks are inherent in the organization and execution of a project such as SHARE. The following general risks, impact and remedial actions are identified, which could influence the success of the project:

| **Risk** | **Impact** | **Remedial action** |
|---|---|---|
| Large number of partners | Inadequate communication; difficult to manage; unclear responsibilities; insufficient participation; insufficient integration | Use of project website; specified leaders for each work package; clear consortium agreement; clear quality procedures; clear description of responsibilities in working plans |
| Start up time of project too short | Organization not ready; personnel not yet employed; activities not synchronized | Three months time between end of negotiation and the start of the project |
| Deliverables not on time | Delay of correlated deliverables; integration cannot start on time | Primary model development complete by month 24, leaving 12 months for review and acceptance; clear working plan; strict management of milestones; definition of critical deliverables |
| Unexpected (or lack of) technical developments | Requirements cannot be met or can be exceeded or superseded | Timely redefinition of requirements in consultation with EC |
| Insufficient participation of experts from institutes and countries not participating directly in SHARE | Insufficient technical content of the models and results; lack of intellectual ownership | Regional meetings with comprehensive involvement and elicitation of national and thematic experts; significant resources reserved in SHARE, role of the technical integrators; joint intellectual ownership of results; embedding of SHARE efforts in the ESC and GEM long-term efforts |
| Lack of quality control | Undetected errors | Formal QA procedures; dedicated WP5 |

The Management Committee is responsible for the identification of the general specific risks of the project and the definition of remedial actions. In the monthly progress confirmations to the project coordinator and the activity coordinator the activity leaders give an update of the activity specific risks.

***Management of communication***

One of the pitfalls of working with a large consortium is the communication and the flow of information. We propose to alleviate this problem by creating centralized project management tools, including a document management system to hold all project reports and documentation; and a tracking system to provide both leaders and researchers with an updated overview of project progress.

We also propose to hold quarterly teleconferences of the Management Committee and Program Office to monitor progress and management of the project, and yearly meetings in person for an in-depth review. There will also be annual review meetings with the General Assembly and Advisory Council, where any participant may raise issues for discussion and resolution. As the work package leaders are together in the WP5, additional communication and joint ownership of technical issues will be achieved. Finally, the leaders of each work package will ensure the regular communication among the partners in each package.

### *B.2.2 Beneficiaries*

The SHARE Consortium includes 18 participants from 13 countries of the Euro-Mediterranean area, European seismological organizations and universities involved in various aspects of seismic hazard assessment:

–**SED-ETHZ** – Eidgenössische Technische Hochschule Zürich, Switzerland

The Swiss Seismological Service at ETH Zürich is the leading institution in seismology and geophysics in Switzerland and the federal office responsible for earthquake monitoring and hazard assessment. The SED conducts service, research and education activities in a wide range of geophysical subjects. The SED has been, and continues to be, a partner or the leader in many EC projects and international projects, including RELIEF, SESAME, SAFE, MEREDIAN, SPICE, EPSI and NERIES. It is a leader in the advancement of unified hazard mapping on a worldwide and European scale, as one of the leading institutions in the UN/IDNDR demonstration project GSHAP – Global Seismic Hazard Assessment Program (1992-1999) and in the SESAME/ESC project on Seismic Hazard Assessment of the Euro-Mediterranean region (1997-2002). In recent years the SED held the Chair of the Board of Directors of ORFEUS, the Presidency of the European Seismological Commission, and the Chair of the International Federation of Digital Seismic Networks. The SED has expertise in seismic hazard and risk assessment, seismotectonics, source dynamics, site effects and microzonations, engineering seismology, global and local tomography, verification seismology, network installation and operation, and geodesy.

**Prof. Domenico GIARDINI** will coordinate the ETH contribution. Professor Giardini is Director of the Competence Center Environment and Sustainability (CCES) of the ETH Domain, Professor of Seismology and Geodynamics at the ETH Zürich and Director of the Swiss Seismological Service. He is past Chairman of the International Federation of Digital Seismic Networks and GEO Participant, and President of the European Seismological Commission.

**Dr. Nicolas DEICHMANN** is Seismologist and deputy director of the SED; responsible for analysis and documentation of seismicity in Switzerland and for the SED's role in monitoring the induced seismicity in Basel; expert in seismotectonics, earthquake location and source mechanics. He will contribute to assess methodologies to harmonize magnitudes and seismic source zones in WP3.

**Dr. Donat FÄH** is head of the Earthquake Hazard and Risk group at the SED. Dr. Fäh's main professional interests are in the areas of seismic hazard assessment, site effects and microzonation, seismic ground motion modeling and historical earthquakes. He will assist in the cooperation and definition of model selection in WP4.

**Dr. Paul Martin MAI** is a senior scientist at the Institute of Geophysics, associated to the research group in Seismology and Geodynamics (SEG), but closely collaborating with the SED. His work addresses the inversion of seismic data for kinematic earthquake source parameters, the dynamics of the earthquake rupture process, and near-field ground-motion simulation for engineering purposes. The activities of his research group are embedded in European projects (FP 6 – RELIEF, FP 7 – SPICE) and cooperation with United States institutions (Southern California Earthquake Center). He will contribute to ground motion model assessment in WP4.

**Prof. Stefan WIEMER** is head of the earthquake statistics groups at the SED. His expertise and research interests include probabilistic and time-dependent seismic hazard assessment, testing of forecast models, statistical seismology and volcano-seismology. He and his group have produced the first time-dependent hazard maps for California and are working on similar models for Europe in NERIES and SAFER. He will serve as SED-ETHZ internal advisor on hazard calculation and model validation in WP5 and coordination efforts with the FP6 Projects NERIES and SAFER.

**Dr. Jochen WOESSNER** is a senior researcher working on various aspects of statistical seismology with special focus on data quality assessment, seismicity analysis and their relation to earthquake physics, time-dependent seismic hazard assessment and earthquake prediction research with strong international collaboration through SAFER and NERIES. Besides his tasks project manager, he will contribute to validation procedures in WP5 and model development. He will serve as WP leader for WP6.

A **junior/senior scientist** is to be hired to perform the hazard computations within WP5.

**Two software engineers** to be hired with strong background in scientific programming and database management will jointly work towards the development of the SHARE computational infrastructure within WP6.

–**GFZ** – GeoForschungsZentrum Potsdam, Germany

GeoForschungsZentrum Potsdam was founded in 1992 as the national research centre for geosciences in Germany and is a member institution of the Helmholtz Association of National Research Centres. With more than 830 staff members, the centre combines all fields of solid Earth sciences including geodesy, geology, geophysics, mineralogy, palaeontology and geochemistry, in a multidisciplinary scientific and technical environment. Research is accomplished using a broad spectrum of methods and techniques, such as satellite geodesy and remote sensing, geophysical deep sounding, scientific drilling, experiments under in situ-conditions, and modeling of geo-processes. By means of very large monitoring and sounding infrastructures, e.g. satellite missions, seismological and GPS networks, magnetic observatories, as well as unique active experiments, GFZ is providing the empirical basement and the information infrastructure with core data services for large scale and supra-national geoscientific ventures, e.g. the ongoing satellite missions CHAMP and GRACE, the International Continental Scientific Drilling Program (ICDP), the Network of Natural Disaster Research (DFNK) and for CEDIM, the Center for Disaster Management and Risk Reduction Technology, to name only a few. The GFZ Data and Computing Centre (DRZ) has the essential task of enhancing and supporting geoscientific projects through allocation of sophisticated solutions for appropriate data and information management, as well as new architectural developments on a world wide scale. Together with regional, national and worldwide partners, GFZ is fostering the creation of spatial data infrastructures (SDI), starting from Brandenburg and other European and Mediterranean regions.

At least since the United Nations-Conference on Early Warning Systems for Natural Disaster Reduction (EWC98) in Potsdam, GFZ is known world wide for its high level expertise in the field of early warning systems. Immediately after the Sumatra tsunami disaster, the German government entrusted the centre to develop and implement an advanced real time tsunami early warning system for the Indian Ocean, in particular for the Indonesian archipelago (GITEWS). The swift integration of complex sensor systems on satellites, ground and ocean bottom constitutes an extremely great challenge. While being implemented, the system is now already being extended to other nations around the Indian Ocean, e.g., Thailand, Sri Lanka and New Zealand. Within the EU FP6, GFZ is currently actively involved in more than 20 projects including the seismology-related projects SAFER (as coordinator), DEWS (as scientific and technical coordinator), TRANSFER, NERIES, and IMAGES.

Section 5.3, Engineering Seismology, has long experience in analysing seismicity, seismotectonics and seismic hazard using techniques that consider the uncertainties in all input parameters. The Global Seismic Hazard Assessment Program (GSHAP) hazard calculations for Europe, as well as the development of the European Macroseismic Scale (EMS), were coordinated from the section. Furthermore, a comprehensive earthquake catalogue for Europe north of the Mediterranean has been compiled within the group. Scientists of Section 5.3 are currently involved in the EC FP6 projects SAFER, TRANSFER and NERIES.

**Dr. Gottfried GRÜNTHAL** is head of section 5.3, Engineering Seismology, since 1992. He has lead numerous research projects on recent crustal stress field modeling, seismotectonics and seismic hazard assessment and acted as head of GSHAP Regional Centre 3 “Central and Northern Europe”. Furthermore, he has edited the EMS and co-edited the GSHAP world map and the follow-up European SESAME seismic hazard map. He will serve as WP leader for WP5 and assist in the construction of a content-wide model of seismic source zones and a homogeneous assessment of expected maximum magnitude earthquakes.

**Dr. Dietrich STROMEYER** is a research scientist in Section 5.3 working, among others, on statistical methods and treatment of uncertainties in hazard assessment. In WP5, he will focus on the generation of synthetic earthquake catalogs and activity rates according to WP3 results.

**Dr. Mathilde B. SØRENSEN** is a post-doctoral researcher in Section 5.3, working mainly on attenuation, probabilistic tsunami hazard assessment, deterministic seismic hazard assessment and seismotectonics. She will on all aspects in WP5 and serve as contact point assisting the WP5 leader.

–**INGV** – Istituto Nazionale di Geofisica e Vulcanologia, Italy

INGV (www.ingv.it) was founded in 1999 by gathering all institutions operating in Geophysics and Volcanology in Italy: former Istituto Nazionale di Geofisica, Osservatorio Vesuviano, Istituto Internazionale di Vulcanologia, Istituto di Geochimica dei Fluidi and Istituto di Ricerca sul Rischio Sismico. Its core department was founded in 1936 under the name Istituto Nazionale di Geofisica as part of the Italian National Research Council. INGV cooperates with universities and other national public and private institutions as well as research agencies worldwide. Its staff includes over 450 full-time scientists and 210 technicians; over 130 post-docs and scholarship holders participate in the research activities every year. With an annual turnover of about €110 million and large research facilities in Rome (headquarters), Milano, Bologna, Pisa, Napoli, Catania and Palermo, INGV is currently the largest European body for research in Geophysics and Volcanology.

The main missions of INGV are the monitoring of earthquake and volcanic activity and the observation of various geophysical phenomena in both the solid and fluid components of the Earth. Much of INGV activity is devoted to 24-hour countrywide seismic surveillance, real-time volcanic monitoring, early warning and forecast activities. State-of-the-art geophysical networks deliver a continuous flow of observations to the acquisition centers of Rome, Naples and Catania, where specialized personnel analyze data around the clock. In addition to being used for research and risk prevention purposes, the data are regularly distributed to the public institutions concerned, to the scientific community and to the public. INGV also performs fundamental research activity in several fields of geophysics of the solid and fluid Earth.

INGV operates in close coordination with the Ministry of University and Research and with Civil Protection authorities, both at national and local level. INGV also cooperates with the Ministry of Environment, the Ministry of Education, the Ministry of Defense and the Ministry of Foreign Affairs in the frame of large research programs of national and international relevance.  Special attention is paid to Education and Outreach through publications for schools, scientific exhibitions and dedicated Internet pages.

INGV features a significant expertise in the assessment of seismic hazard at various scales. Its Milan department (INGV-MI) specializes in the compilation and management of large seismicity databases and in the elaboration of data and tools to assist the legislation and the practice of seismic hazard assessment. Its large Rome 1 department (INGV-RM1) focuses in the experimental and theoretical investigation and modeling of seismogenic processes; in the investigation of the seismic source, earthquake propagation and site response; and in the creation and maintenance of databases of active seismogenic sources.

INGV research team:

**Dr. Gianluca VALENSISE** (INGV-RM1) has is a leading expert in earthquake geology, the study of historical earthquakes, active faults and slow crustal deformation. He is the driving force in the compilation of the Italian Database of Individual Seismic Sources (DISS) and the past leader of the EC FAUST project. He will serve as WP leader for WP3.

**Dr. Salvatore BARBA** (INGV-RM1) has coordinated a research group for developing a numerical strain model for the Mediterranean and is actively involved in its improvement. He is presently coordinating a large project on improving the input for seismic hazard assessment in Italy. He will co-lead the generation of crustal strain rate models for Europe (WP3).

**Dr. Roberto BASILI** (INGV-RM1) has participated in previous EC-funded programs on seismicity and seismic hazard (FAUST, SAFE) and has recently led the update of Italy's Database of Individual Seismogenic Sources. He specializes in the quantification of geological input to seismic and tsunami hazard. He will actively contribute to the European database of active faults (WP3).

**Dr. Massimiliano STUCCHI** (INGV-MI) has led previous EC-funded programs on seismicity (Rhise, BEECD, a module of NERIES) and has coordinated a project for the assessment of seismic hazard in Italy (2003-2005). He has coordinated the setup of the Euro-Mediterranean Intensity Database (2002)

and of Italy's Database of Macroseismic Observations (2004 and updates). He will critically contribute to homogenize the European earthquake database (WP3).

**Dr. Carlo MELETTI** (INGV-MI) has been in charge of the compilation of the most recent seismic source zone model and has coordinated a project for the assessment of seismic hazard in Italy (2006-2007). He devotes his expertise to homogenize seismic source zones on the European level and the quality assessment of hazard results (WP5).

–**LGIT-UJF** – Laboratoire de Géophysique Interne et Tectonophysique, Université Joseph Fourier, France

LGIT (www-lgit.obs.ujf-grenoble.fr) is an earth sciences laboratory with about 60 scientists, 25 engineers and 45 PhD students. The Seismic Risk group of LGIT will contribute to the Ha-Ha project. This team (12 scientists, 3 engineers and 7 PHD students) is developing new methods to improve the knowledge of local site effects and simulate ground shaking of large earthquakes. This group is also in charge of the technical management of the French accelerometer network (100 stations) and is conducting several seismic risk research projects at the local, national, European and International levels (e.g., the SESAME, SISMOVALP and NERIES European projects). The team's goal is finally to disseminate these research results to civil engineers and local authorities in order to reduce our vulnerability to earthquakes. The team is also very deeply involved in teaching at the graduate and postgraduate levels, including for instance an active participation to the ERASMUS-MUNDUS master programme (MEEES, http://www.meees.org) for the engineering seismology field (15 students in 2005-2006, 24 in 2006-2007, 18 in 2007-2008).

**Prof. Fabrice COTTON**, Professor in Geophysics at University Joseph Fourier (Grenoble) and Director of LGIT (http://www-lgit.obs.ujf-grenoble.fr/~cotton), will coordinate the LGIT-UJF work in SHARE. He is author or co-author of over 40 publications on referenced international journals. The principal focus of his research is the characterization of strong ground-motion with a special emphasis on source effects and the improvement of European rock ground motion models. His most recent project (as coordinator) is the SISMOVALP European project (2004-2007), dedicated to the site characterization and the propositions for new design spectra in Alpine valleys. He recently has been elected as junior member of «Institut Universitaire de France». He will serve as WP leader for WP4.

**Prof. Pierre-Yves BARD** (http://www-lgit.obs.ujf-grenoble.fr/~bard/) will strongly contribute to the project in WP4. His research field, at the interface between seismologists and earthquake engineers, is dedicated to the estimation of strong ground motion, with a special emphasis on any kind of site effects. His most recent achievements were the SESAME European project, dedicated to the use of ambient vibrations for site characterization, and the propositions for a new seismic zonation in France with new spectra. He is actively involved in the French Association of Earthquake Engineering, and served as an expert for various projects and review panels. He has supervised more than 25 PhD students, and co-authored around 75 papers in peer reviewed international journals, and twice more in Conference Proceedings.

–**UPAV** – Università degli Studi di Pavia, Italy

The University of Pavia is one of the oldest universities in Europe; an edict issued by King Lotarius quotes a higher education institution in Pavia as already established 825 A.D. Enlarged and renovated by the Duke of Milan, Gian Galeazzo Visconti, it became the University of the Duchy having been officially established as a studium generale by Emperor Charles IV in 1361.

The Structural Mechanics Department of the University of Pavia (www.unipv.it) has been very much engaged in earthquake engineering research for more than two decades, having been involved in a myriad of International and National research projects in this field, assuming the role of coordinator in many of them. The most prominent of the latter is certainly the FP6 LESSLOSS (Risk Mitigation for Earthquakes and Landslides, www.lessloss.org) endeavour, a EU-funded research network involving the participation of 46 European partners, including

universities, research institutions, construction companies and material/components manufacturers.

In addition, the Earthquake Engineering group of the University also runs the Centre for Graduate Studies in Earthquake Engineering and Engineering Seismology (ROSE School, www.roseschool.it), with over 100 postgraduates permanently engaged in advanced studies and research in Earthquake Engineering and Engineering Seismology. All lecturers at the ROSE School are internationally recognised experts in their field, coming from a number of distinguished institutions from around the world. In recognition of the high quality of its earthquake engineering training programme, the European Commission has recently, approved and financed the setting up in Pavia of an Erasmus Mundus Masters programme in Earthquake Engineering and Engineering Seismology (MEEES, www.meees.org).

UPAV is also one of the founding members of the European Centre for Training and Research in Earthquake Engineering (EUCENTRE, www.eucentre.it), a multidisciplinary infrastructure based in Pavia that is involved in several research projects for private companies (manufacturers, consultants, software developers, industry) and public institutions (national civil protection, regional administrations, universities), that contributes to the drafting of national seismic design regulations and guidelines, and that supports local planning agencies in the implementation of seismic risk mitigation measures.

Professor Michele Calvi, Dr Rui Pinho and Dr Helen Crowley will coordinate UPAV activities in this project.

**Dr. Michele CALVI** is Professor of Structural Design at the University of Pavia, Director of the ROSE School and President of the EUCENTRE. He has published more than 200 publications in the field, including widely adopted textbooks, and is Associate Editor of the Journal of Earthquake Engineering. Prof. Calvi coordinates also a large number of national and international applied research projects, and has also been involved in important construction projects worldwide, such as the Rion Bridge in Greece and the structural retrofitting of the Bolu Viaduct in Turkey. He will serve as WP leader of WP2.

**Dr. Rui PINHO** is Assistant Professor of Structural Design at the University of Pavia, Head of the Seismic Risk Section at the EUCENTRE, Deputy Coordinator of the LESSLOSS project, of the ROSE School and of the MEEES programme. Dr Pinho is author and co-author of over 100 publications, and guest speaker at more than 20 conferences, workshops and short courses. He is also peer reviewer and/or editorial board member for a large number of international journals, and has also been involved, as an external consultant, in a number of consultancy projects involving seismic assessment and retrofitting of existing structures. He will serve as WP leader of WP7 and thus be involved in all tasks.

**Dr. Helen CROWLEY** is Researcher at the Seismic Risk Section of the EUCENTRE, where she is responsible for the coordination of a number of national and international research projects, mainly in the areas of seismic vulnerability of buildings at varying geographical scales and the evaluation of seismic risk and economic loss. Dr Crowley has authored more than 40 publications in the field of earthquake engineering and serves as editorial board member or peer-reviewer for a number of international journals. She will be focussing on the evaluation of proposed concepts risk scenario in WP2.

Finally, it is also noted that within the scope of this project UPAV plans to active cooperation endeavours with earthquake engineering and/or engineering seismology research groups from Imperial College London, INGV, University of Patras, and University of Rome, lead respectively by Prof. Julian Bommer, Dr. Massimiliano Stucchi, Prof. Mike Fardis, Prof. Paolo Pinto. This aims at bringing into the project the experience and expertise accumulated by such

research groups, who have and continue to play a vital role on the development of European research and regulations in the field of earthquake engineering.

–**AUTH** – Aristotle University of Thessaloniki, Greece

The Laboratory Unit of Soil Dynamics and Geotechnical Earthquake Engineering of the Department of Civil Engineering of Aristotle University of Thessaloniki (AUTH-SDGEE) headed by Professor Kyriazis Pitilakis, in cooperation with the Laboratory of Geology of the Department of Geology (AUTH-GEO) headed by Professor Spyros Pavlides, have a long experience in many topics of geotechnical engineering and engineering geology.

The main research activities of AUTH- SDGEE are: geotechnics and geotechnical earthquake engineering, soil dynamics, engineering seismology, site effects and ground motion, SSI effects, lifeline earthquake engineering and seismic vulnerability assessment and mitigation of structures. Several selected (1994-present) European research projects that the group of AUTH has coordinated and/or participated are: EUROSEISTEST, EUROSEISMOD, EUROSEISRISK (http://euroseis.civil.auth.gr), RISK-UE (An advanced approach to earthquake risk scenarios with applications to different European towns), CORSEIS (An integrated study of seismic hazard assessment in the area of Aigion Gulf of Corinth, Greece), 3HAZ (Earthquakes, tsunamis and landslides in the Corinth rift, Greece. A multidisciplinary approach for measuring, modeling and predicting their triggering mode and their effects), LESSLOSS (Risk Mitigation for Earthquakes and Landslides), MERP (Marmara Earthquake Rehabilitation Project) and NEMISREF (New Methods for Mitigation of Seismic Risk of Existing Foundations).

The research team of AUTH-GEO has long experience in national and international research regarding active faulting, paleoseismology, neotectonic mapping, kinematics, liquefaction, etc. Its members have been actively involved in several research projects related to the main objectives of the proposed one, including identification and quantification of active faults in selected areas of the broader Aegean area.

**Professor Kyriazis PITILAKIS** (URL: http://geo.civil.auth.gr/Staff/dep/pitilakis/) has more than 30 years of intensive academic, research and professional experience and an international reputation in earthquake geotechnical engineering and geotechnical engineering. He has coordinated and participated in many important research and engineering projects in Greece, Italy, Cyprus, Turkey, Japan, France, Spain, and few Balkan countries and he has been involved in many post earthquake and post landslides evaluation projects. Author of numerous scientific papers (>250) and invited lecturer in many international conferences and workshops, he was chairman of the last 4ICEGE (www.4icege.org). Ex-Chairman of the Board of Directors of the Institute of Engineering Seismology and Earthquake Engineering in Greece and ex-chairman of the Department of Civil Engineering of AUTH. Recently honoured by the France Republic “Chevalier des Palmes Academics”. He will contribute to and advise co-workers on risk scenarios and the consensus reference Eurpoean zonation model (WP2) and coordinate expert elicitation (WP4).

**Professor Spyros PAVLIDES**, currently serving as acting president of the Department of Geology and deputy President of the Geological Society of Greece. He has extended experience in developing and coordinating research projects, and has published extensively on issues related to active faulting of Greece and the broader area. He is reviewer in a score of international journals and has organized, either as a chairman or as a member of the organizing committee, a lot of international conferences. He will co-coordinate data selection for a homogeneous data collection for Greece and the eastern Mediterranean region (WP3).

**Assoc. Professor Dimitrios RAPTAKIS** (raptakis@civil.auth.gr) is specialized in engineering seismology, seismic ground motion, site effects, and geophysical methods for soil and site characterization. He is author of 68 scientific papers in journals and conferences, has participate in many national and international research projects. He will contribute to sensitivity studies and risk scenarios for selected European cities (WP3).

**Dr. Anastasios ANASTASIADIS,** lecturer in AUTH, author of more than 50 scientific papers, specialist in laboratory and in-situ testing, soil and site characterization in geo technical and earthquake

engineering, site effects and microzoning studies, seismic performance and design of geotechnical structures and infrastructures (WP4).

–**BRGM** – Bureau de Recherches Géologiques et Minières, France

BRGM is the French Public Institution responsible for mobilizing Earth Sciences in the sustainable management of natural resources and the subsurface domain. It contributes advice and expert assessments to public authorities and it participates in many research and international projects. BRGM research and development programmes support innovation and work in the following areas: mineral resources, groundwater, development planning and natural risks, environment and pollution, environmental metrology, mapping, digital information systems, CO2 storage and geothermal energy.

For the past few decades, BRGM has been involved in various seismic hazard and risk French, European and international projects. For the last decade this work has been conducted through its Development Planning and Natural Risks Division. Recent earthquake-related European research projects have included: Risk-UE (in FP5), which was coordinated by BRGM, LESSLOSS (in FP6), in which BRGM played an important role, and SISMOVALP (Interreg III). In addition, BRGM is responsible for many aspects of the French government's Plan Séisme, a current initiative to reduce earthquake risk in France.

BRGM's Information Technology and Systems Division is greatly experienced in the gathering, storage, structuring and dissemination of data for natural hazard assessments and for other tasks. For example, BRGM is a partner in the FP6 Integrated Project ORCHESTRA concerning the development of an open information technology architecture and services for risk management and also is heavily involved in the implementation of the European INSPIRE Directive on the dissemination of geospatial data. In addition, it is in charge of data management for access to the Geoportail of the French Government.

**Dr. John DOUGLAS**, researcher in engineering seismology, will coordinate BRGM's contribution to SHARE. He has authored and co-authored about 25 articles in scientific and engineering journals (and numerous others in international conferences), mainly concerning the estimation and evaluation of earthquake shaking but also on other subjects such as the calculation of earthquake magnitudes and also multi-risk assessment. Since joining BRGM he has been heavily involved in the FP6 IP ORCHESTRA. He will co-coordinate expert elicitations (WP4) and contribute to calibrating rock models for peak ground motions.

**Jean Jacques SERRANO** (researcher in information technology), has direct experience in INSPIRE, firstly as part of the Implementing Rules drafting teams, but he also chairs the Network services drafting team. He also participated in the European ORCHESTRA project to design an open-service-oriented architecture for risk management in Europe. He focuses in WP6 on designing and implementing Web services as well as Portal design.

–**CRAAG** – Centre de Recherche en Astronomie, Astrophysique et Géophysique

CRAAG is the Algerian Research Institute that operates the Algerian Seismic Network and the official governmental agency in charge of national seismic hazard assessment. It develops several research studies in several fields: seismology, seismotectonics, crustal deformation, seismic hazard assessment, microzonation and education of the population, with specific focus on northern Algeria, the seismically active part of the country.

CRAAG plays also a key role in the national seismic risk reduction programme developed recently after the Boumerdes 2003 earthquake, as the strategy recently launched by the government is based on the research studies of the CRAAG. This is the case for the new land management programme in favour of the development of the High Plateaus and the program of building one new million house.

**Dr. K. YELLES** is the director of CRAAG and will co-lead earthquake data collection and seismic source zone definition efforts for the Magrheb region and the associated Mediterranean and Atlantic offshore with IST. He will supervise his co-workers in the tasks of WP3.

**Dr. D. HAMOU** is research director at CRAAG and head of the seismotectonics laboratory. He is currently leading critical projects concerned with updating the Algerian seismotectonic definition. He will supply important information to the definition of seismic source zones in WP3.

**Dr. F. SEMMANE** is senior researcher at CRAAG with expertise in finite fault model inversions and the computation of strong ground motion. He will focus on the update of the definition of seismic source zones in WP3.

**Dr. A. KHERROUBI** is senior researcher at CRAAG with strong expertise in seismicity analysis and seismic hazard assessment. He will contribute to update and integrate the Algerian seismic catalogue in WP3.

–**IST** – Instituto Superior Técnico, Portugal

IST is the leading higher education school of Engineering of Portugal, with a strong emphasis on technological research and development. IST is a member of various European networks of prestigious schools of Engineering, Science and Technology, such as CLUSTER, TIME, and CESAER. Research and services contribute to about half of the IST turnover. IST hosts several research units, among which ICIST (66 PhD researchers, Natural Hazards, Land Use Planning, Geomatics and others). IST is a key player of the novel National Geophysical Network, currently being implemented in Portugal under the initiative of the national research foundation FCT.

Within ICIST, the Earthquake Engineering and Seismology Group (14 Ph.D. researchers) is focussed on the mitigation of seismic risk in Portugal, with special attention to the characterization of the seismic hazard through the study of seismicity, seismic sources, attenuation and site effects. ICIST operates a local network of broadband seismic stations near Lisbon (TAGUSNET project, funded by FCT), and is currently installing the regional very broadband network NAVIGATORS (Azores - Madeira - South Morocco - SW Iberia), funded nationally (National Scientific Re-Equipment Programme, FCT). ICIST conducted several paleoseismological studies, namely in the Lower Tagus Valley (Vilanova and Fonseca, J. Seismology, 2004).

**Dr. Joao FONSECA** is Assistant Professor of Geophysics at IST, and his research is focussed on the assessment of seismic hazard in Portugal, as well as seismic monitoring. He has coordinated several research projects funded by FCT (TAGUS, TAGUS2, TAGUSNET), and he has conducted several hazard studies under contract, mainly for dam site selection. He will co-lead with CRAAG the determination of seismic source zones for the Ibero-Magrheb area.

**Dr. Susana VILANOVA** is first author of several publications on the hazard assessment of SW Iberia, including the first probabilistic hazard map for Portugal in terms of PGA (BSSA, 2007). She will contribute to WP3 supplying earthquake and seismogenic source data.

–**KOERI** – Kandili Observatory and Earthquake Research Institute, Bogazici University, Turkey

Being established in 1868, KOERI (then, Imperial Observatory) has a tradition of science that encompasses the initiation formal meteorological observations in 1911 and also the start of the systematic seismological measurements in 1926 in Turkey. After annexation to Bogazici University (originally founded in 1863 in Istanbul as Robert College), KOERI has evolved into a multidisciplinary earthquake research organization providing graduate education under the Earthquake Engineering, Geophysics and Geodesy departments and encompassing earthquake observation, research and application services within a single, integrated body.

The Earthquake Engineering Department has started its activities in 1989 as a graduate department under KOERI of Bogazici University. The overall mandate of the department is to conduct graduate level training, research and implementation that will contribute to seismically safer structures, systems and environment. The emphasis of academic activities in relation to the proposed project are placed on: Earthquake hazard and risk analysis; Characteristics of strong earthquake ground motion; Simulation of strong ground motion, Assessment of landslide hazard; Development of urban earthquake damage scenarios; Site and soil response analysis.

Observational and theoretical strong motion studies constitute a major part of current activities. Observational studies include permanent strong motion networks and temporary strong motion instrumentation. About 200 digital strong motion accelerographs are owned and operated by KOERI as dense urban network in and around Istanbul (Rapid response and early warning system, structural

instrumentations). In addition to ground motion research, the data from this dense urban network is used to provide rapid post-earthquake loss information. Online data from strategically located 10 stations comprise the Istanbul earthquake early warning network. Substantial effort has been devoted to the analysis and interpretation of field-data in view of earthquake source parameters, source models, local site effects and near-field effects. KOERI has taken and currently takes active roles in the EU FP6 projects titled: LESSLOSS, NERIES, SAFER and TRANSFER.

KOERI's work will be coordinated by **Dr. Mustafa ERDIK** who is a Professor of Earthquake Engineering at Kandilli Observatory and Earthquake Research Institute in Bogazici University in Istanbul. He is a member of the editorial board of several professional journals and serves in the executive board of several professional societies. He has authored or co-authored more than 200 scientific papers and 5 books. In 1999 he was elected as the laureate of United Nations Sasakawa Disaster Prevention Award and he has received the NATO Science for Peace – Summit Prize in 2004. His current research interest is on earthquake hazard and risk assessment and he undertakes related responsibilities in the EU-FP6 NERIES and SAFER projects. He and his co-workers will be responsible in WP4 for knowledge transfer from EU-FP6 projects to SHARE, to assist in risk scenario modelling and supply data for the Eastern Meditarrenean (WP3).

–**LNEC** – Laboratório Nacional de Engenharia Civil, Portugal

The Laboratório Nacional de Engenharia Civil, I.P. – LNEC, I.P., established in 1946, is a public Science and Technology institution, occupying a 22 ha campus in Lisbon, with activity in the various fields of Civil Engineering and like areas. Its main assignments are the execution, supervision and promotion of the scientific research and technologic development necessary for achieving progress, innovation and good practice in Civil Engineering. The institution is also responsible for providing technical support to the executive power, in its governing and regulatory activities. Presently, it has about 680 staff elements, of which approximately 22% are PhD researchers. It also has about 80 scientific research fellows with a grant awarded by LNEC, I.P.

LNEC, I.P. has a long experience in the field of Earthquake Engineering, offering services in experimental testing, structural monitoring, risk assessment, numerical modeling, development of codes and consultancy. It has been responsible, from the beginning, for the preparation of the Portuguese regulations for seismic design, dating from the late fifties/early sixties. Furthermore it holds, since its starting, the Secretariat of the Subcommittee of CEN responsible for the preparation of Eurocode 8. Additionally is a founding member of the European Association of Structural Mechanics Laboratories and has participated in several European research networks within 4th, 5th and 6th FW-Programmes of EU, namely the recently finished LESSLOSS project. In the field of earthquake risk assessment, LNEC, I.P. holds a leading position in Portugal in the areas of seismic hazard, characterisation of the seismic action and evaluation of risk. LNEC, I.P. also supports Civil Protection Agencies regarding emergency planning and seismic risk mitigation. In the experimental field LNEC, I.P. has a large facility with 2 shaking tables, one of them 3D, which has been included in the European Large Scale Facilities in 1995. From the several co-operative research activities, significant and consolidated links have been established with most of the European research institutions working in the field of Earthquake Engineering.

The research team of the IP will be composed by Dr. Ema Coelho, Principal Research Officer and Head of the Earthquake Engineering and Structural Dynamics Division (NESDE) of Structures Department (DE) of LNEC, together with Dr. A. Campos-Costa, Principal Research Officer, Dr. Maria Luísa Sousa, Research Officer and Dr. Alexandra Carvalho external collaborator (applying to LNEC Research Officer).

**Dr. Ema COELHO** has significant experience in Earthquake Engineering research; her main interests have been in the fields of structural nonlinear analysis, reinforced concrete and masonry structures, assessment, repair and strengthening of buildings, seismic testing and development of codes. She is the Technical Secretary of CEN/TC250/SC8 and member of the Portuguese Committee for the Implementation of Eurocodes. She has been involved in many research co-operation activities, having acted frequently as leader of research groups. She has more than 100 publications, as author or co-

author, among them technical reports, papers, and other documents. She will coordinate the Coordination with CEN/TC250/SC8 in WP2.

**Dr. A. CAMPOS-COSTA** has significant experience in Earthquake Engineering research; his main interests have been in the fields of structural dynamics, seismic hazard, vulnerability and risk assessment, repair, strengthening and assessment of structures, and seismic testing. He has participated in several research co-operation activities and has been the scientific responsible for seismic hazard studies developed for the Portuguese National Annex of Eurocode 8. He has more than 100 publications, as author or co-author, among them technical reports, papers, and other documents.

**Dr. Maria Luísa SOUSA** has participated in several international (e.g., LESSLOSS) and Portuguese research projects. Presently, she is responsible for the coordination of some national research projects in the field of seismic loss modeling. Dr. Maria Luísa Sousa is author and co-author of over 75 publications. Her main fields of activity are seismic hazard and risk assessment. She also participated in the seismic hazard studies developed for the Portuguese National Annex of Eurocode 8 (part 1). She will focus on scenario modelling in WP2.

**Dr. Alexandra CARVALHO** has participated in LESSLOSS and several other international and Portuguese research projects. Her main interests are ground motion modeling, finite-fault stochastic modeling and seismic hazard and she has recently been involved in the Portuguese seismic zonation for the National Annex of Eurocode 8. She will focus on scenario modelling in WP2.

–**METU** – Middle East Technical University, Turkey

METU, Middle East Technical University (www.metu.edu.tr, Ankara, Turkey), has been actively involved in earthquake engineering research since the early 1970's. Researchers from three different departments have been contributing to the earthquake engineering research, namely the Departments of Civil Engineering, Geology and Engineering Sciences. The total number of scientists active in this field is about 20.

Seismic risk assessment at the urban scale had been a primary research focus at METU following the 1999 Marmara earthquake which killed 20,000 people and caused economical losses exceeding 10 billion €. The basic motivation for urban risk assessment was the calculated odds for a severe earthquake effecting metropolitan Istanbul area, which is estimated as 60% within the next 30 years.

METU conducted a NATO Science Project on the large-scale urban vulnerability assessment of building stocks following the 1999 Marmara and Düzce earthquakes. An extensive field study had been carried out for correlating the observed damages with the general properties of the buildings, and for establishing a building vulnerability repository. Accordingly, fragility functions have been developed for typical classes of vulnerable buildings. Furthermore, rapid screening procedures have been established for the seismic risk assessment of vulnerable Turkish building stocks.

METU is the technical coordinator of the Istanbul Earthquake Master Plan project supported by the Istanbul Metropolitan Municipality. Prioritization of seismic risk in the existing "one million plus" buildings in Istanbul is the primary objective of this study. Risk prioritization is based on the estimated seismic hazard and calculated vulnerabilities. The risk assessment procedures developed by METU are currently being implemented in the Zeytinburnu, Fatih and Kucukcekmece sub provinces of Istanbul to a total number of 110,000 buildings. METU was a partner in the FP6 LESSLOSS project, and contributed to the cluster "Techniques and Methods for Vulnerability Reduction". METU has also participated in the State-of the-Art-Report on "Seismic Microzonation for Municipalities", prepared by DRM in 2004.

Currently, METU conducts the "Compilation and standardization of Turkish strong ground-motion database" that is funded by the Turkish Scientific and Technological Research Council. METU also acts as the NATO project director of the NATO Science project entitled "Harmonization of seismic hazard maps in Western Balkans."

METU's contribution to SHARE will be led by **Prof. Sinan Akkar**. Professor Akkar is the Principal Investigator of the Turkish strong motion standardization program. He is also the NATO Project Director of the Harmonization of Seismic Hazard Maps in Western Balkan Countries. Dr. Akkar also co-authored

the latest Euro-Mediterranean ground motion prediction equations. He will lead the compilation of the strong-motion database in (WP4) and advise to be hired co-workers on all aspects in WP4.

**Prof. Polat Gülkan** is an earthquake structural engineer affiliated with the Earthquake Engineering Research Center and the Disaster Management Research Center, both at METU. He has served on the Board of Directors of the International Association for Earthquake Engineering (IAEE) between 1996 and 2004, and was appointed as executive president of the same organization in 2004 for a four-year term until 2008. He also served on the Board of Earthquake Engineering Research Institute (EERI) for the period 2005-2008, and is currently Editor for the journal Earthquake Spectra. His professional work has dealt also with earthquake hazard, culminating in the earthquake hazard zones map for Turkey that went into effect in 1966, spatial planning, urban hazard assessment, natural disaster insurance, structural intervention principles for buildings and nuclear safety. He will assist and advise to be defined co-workers on all other aspects of WP4.

–**MSO** – Montenegro Seismological Observatory, Montenegro

*Montenegro Seismological Observatory* was founded 48 years ago to observe and study earthquake phenomenon on the territory of Montenegro and surrounding regions. It is governmental institution having staff of 11 employees.

MSO performs monitoring, analysis of weak and strong earthquake motion data. It is in charged for maintaining state seismic network of ten short-period stations and currently reports earthquake parametric data to many local and international agencies. Also, MSO perform real-time seismic waveform data exchange with the number of surrounding national networks.

Besides the instrumental and fundamental seismology, this institution realizes engineering seismology studies, field seismic and other geophysical research of the shallow earth crust. It is also involved in planning of earthquake prevention and preparedness measures.

Montenegro Seismological Observatory has been involved in realization of a great number of important regional projects such are: International UNESCO/UNDP regional Project Survey of the Seismicity of the Balkan region, part for Montenegro, 1973 – 1976, International UNDP/UNESCO project "Seismic risk reduction in the Balkan Region", part for Montenegro, 1982 – 1985, Seismic regional zoning of Montenegro, including field geophysical investigation, 1984 – 1986, Seismic microzoning for all urban area of all communes of Montenegro, 1982 – 1987, etc.

MSO is the leading partner in the ongoing NATO SfP Project “Harmonization of Seismic Hazard Maps for The Western Balkan Countries” (2007-2010).

**Prof. Branislav GLAVATOVIC**, the MSO contact point for this Project, is Director of the Seismological Observatory of Montenegro, Podgorica and Professor of the University at Podgorica, author of 42 scientific publications, with main scientific activities in seismic hazard assessment, seismicity analysis, digital seismic acquisition, global geodynamics, gravity modeling, applied geophysical studies, etc. He will be responsible for supplying earthquake and seismogenic source data for the entire Balkan region (WP3) and the coordination with the ongoing NATO SfP 983054 Balkan Seismic Hazard project (WP5).

–**NERC-BGS** – Natural Environment Research Council-British Geological Survey, UK

NERC is the UK's main agency for funding and managing research, training and knowledge exchange in the environmental sciences. The British Geological Survey (BGS) is a research centre owned by NERC and is the UK National Centre for Earth Science information and expertise. The role of the Survey is to acquire and maintain up-to-date knowledge of the UK landmass and its adjacent continental shelf by systematic geological, geophysical, geochemical, hydrogeological and geotechnical surveys. It undertakes high-quality research to underpin its strategic activities. Many of the BGS scientific groups apply their capabilities overseas, and the BGS International Group co-ordinates these activities.

BGS operates the National Geosciences Information Service (NGIS), which is the focus for the nation's geosciences data and information. It represents the public interface to the Survey's data resources and expertise, and it is responsible for the provision of advice on geological matters and for the dissemination of data in forms meaningful and relevant to end users.

The BGS corporate aims include:

–Meeting the requirements of users by providing relevant, comprehensive and up-to-date information, services and advice to the highest modern standards;

–Operating at all times to the highest professional standards;

–An emphasis on impartiality, confidentiality, reliability and promptness.

BGS has 780 members of staff and an annual turnover of about £40 million. It is a component body of the Natural Environment Research Council, which has 2500 staff and a turnover of approximately £160 million.

The Seismology and Geomagnetism Programme of the BGS has a combined staff of around 40. Since 1970 the functions of this group have included maintaining the UK national seismic monitoring network, which now consists of a network of over 140 seismic recording instruments. BGS has been active in the field of seismic hazard research since the mid 1970s. As well as dealing with seismic hazard in the UK, BGS staff have been involved in numerous studies of seismicity or seismic hazard in many parts of the world. BGS is recognised internationally as an authority on seismic hazard methodology and associated software development. BGS has been involved in several large international projects in the field of seismic hazard, including the Global Seismic Hazard Assessment Programme (1992-1999) in which BGS was the responsible member for the North Balkans area as well as for the British Isles. BGS was also involved in the follow-up project SESAME for the Mediterranean area.

The participation of BGS will be led by **Dr. Roger MUSSON**, who has twenty years of experience in seismic hazard research, and was the lead author of the Eurocode 8 seismic hazard maps for the UK. He will co-lead the earthquake data collection and seismic source zone definition in the North Sea, Atlantic offshore and polar regions (WP3) and advise co-workers to be defined on these topics.

–**NIEP** – National Institute for Earth Physics, Romania

NIEP is an organization for research and development in Earth sciences established in 1977, coordinated by the Romanian Ministry for Education, Research and Youth. The structure of the NIEP consists of 6 departments, 53 researchers (18 PhD), 47 technical people and 16 PhD students. It has a wide background in earth sciences research, with focus on seismic source and seismotectonics, seismic hazard assessment, site effects and microzonation, lithosphere structure and dynamics, earthquake prediction, assessment and mitigation of seismic risk. Also, NIEP ensures Romania's technical contribution to global seismological monitoring in support of the Comprehensive Nuclear-Test-Ban Treaty (CTBT).

As main task, NIEP carries out the seismic survey of Romania and operates the national seismic network consisting of 18 short-period stations, 14 of them located in the Eastern and Southern Carpathians and telemetered to Bucharest, 4 stations sited in the Western part of Romania and telemetered to a regional recording center. NIEP also operates a free-field strong motion network consisting of 58 digital K2 seismic stations and 28 SMA-1 accelerometers for recording the strong and moderate Vrancea earthquakes. Data recorded by 12 additional broadband stations are transmitting continuously to the Bucharest data centre, using satellite communications links. Key issues are: the development of an advanced seismic data collection and management system, including robust real-time data acquisition techniques, reliable communications links; rapid processing and exchange of earthquake information, creating and handling of large data sets; compilation of bulletins and earthquake catalogues. Of highest priority is the real-time determination of hypocenters in all seismic regions of Romania and rapid estimation of damage in case of destructive earthquakes.

A recent crucial NIEP strategy issue is to enhance the application of basic research to earthquake risk reduction, and to integrate our physics-based results in urban security problems. To this aim, NIEP will promote and develop the interface between understanding earthquake process and communicating this understanding to engineers, emergency managers, government officials, and the civil society.

NIEP's contribution to SHARE will be led by **Dr. Mircea RADULIAN and Prof. Dr. Gheorghe MARMUREANU**. Dr. Radulian is a senior researcher specializing in seismic source, seismotectonics and seismic hazard field and author of 122 scientific papers. Prof. Dr. Marmureanu has with 30 years of experience in soil dynamics, microzonation and seismic hazard. Dr. Radulian will furnish earthquake data collection and seismic source zone definition for the entire Balkan region (WP3) assisted by Dr. Marmureanu.

–**NKUA** – Seismological Laboratory, University of Athens, Greece

The roots of the Seismological Laboratory of University of Athens are traced back to 1929. Hence, the NKUA/SL has evolved to its present status, expanding its research interests in most areas of pure and applied seismology and geophysics.

Since Greece experiences very high levels of seismicity, the problem of earthquake risk prevention and hazard mitigation is central to the NKUA/SLs agenda. During the last 60 years the Seismological Laboratory has greatly contributed to the scientific advances in the field of Seismology and Applied Geophysics in Greece. In the course of its activities over the years, a better understanding of the seismicity, seismic hazard and seismic risk of the area of Greece was accomplished. Several local seismic networks were deployed, monitoring the seismicity and determining the seismotectonic regime of certain seismogenic areas.

Moreover, applications of theoretical seismology to Greek data resulted in revised and/or local seismic intensity and seismic energy attenuation laws and in the determination of seismic source parameters for a large number of earthquakes. Furthermore, microzonation studies aiming at the mitigation of seismic risk were performed. In recent years, major advances were also made in the field of Geophysics and Engineering Seismology, mainly due to the application of dynamic, seismic, electromagnetic and magnetotelluric methods. Emphasis is given on the application of modern methodologies, i.e. seismic and geoelectric tomography, high-resolution reflection including shear waves reflection, etc.

NKUA has acted as coordinator or partner in many national and international research projects funded financed by Greek institutions (EPPO, GSRT, PPC etc.) as well as by the European Union: 1. Seismotectonic study in Peloponessus, Greece, N ST2J-0121-GR. 2. Seismotectonic study of the Aegean Sea, N ST2J-0353-C. 3. Review of Historical Seismicity in Europe, N EV46-0106-GR. 4. Seismic Behavior and Vulnerability of buried lifelines CT91-0039. 5. High Quality Strong Motion Data, CT91-0042 6. Seismic Electrical Signals, CT91-0045. 7. EURO-SEISTEST, CT93-0281. 8. A basic European earthquake catalogue and a database for the evaluation of long-term seismicity and seismic hazard, CT94-497. 9. Broadband magnetotellurics for earthquake prediction research CT94-449. 10. Hydrothermal Fluxes and Biological Production in the Aegean, MAS3-CT95-0021. 11. European Network on Seismic Risk, Vulnerability and SAFER - Proposal N.036935 Drafting date: 28 February 2006 108 Earthquake Scenarios, IC15-CT96-0203. 12. Assessment of capacity of soil gas radon monitoring in various active fault zones for prediction of earthquake occurrence, IC15-CT96-0214. 13. DGLab, ENV4-CT98-0741. 14. Deep Geodynamic Laboratory- Gulf of Corinth, EVG1-CT-1999-00027. 15. CORSEIS, EVG1-CT-1999-00002. 16. 3HAZ-CORINTH, P004043 17. SAFER - P036935 18. NERIES, Prog.: FP6-2004-infrastructures-5, Activity:INFRAST-2.1,N:026139, 2006.

**Professor Kostantinos C. Makropoulos** will lead the NKUA effort in SHARE. He is Professor of Seismology, Dean of School of Sciences of University of Athens since 2002, and President of EPPO since 2005. Specialisation: Seismicity, earthquake hazard, risk analysis, earthquake engineering. He has published more than 220 original scientific papers in international journals and proceedings of international conferences and has supervised the diploma dissertations and PhD theses of more than 50 students. He was the Greek focal point and member of the steering committee of the SEISMED project. He has been participating, as main contractor or partner, in all the projects mentioned in the previous

paragraph. He will assist to coordinate data selection for a homogeneous data collection for Greece and the eastern Mediterranean region (WP3).

**Asst. Professor Panayotis PAPADIMITRIOU** (Geophysics Department, University of Athens) will participate. Research Interests: Source parameter determination and study of seismic sources using body wave modeling. Development of improved theoretical and computational methods of treating seismic wave propagation in realistic earth models. Development of seismological networks, monitoring microseismic activity. He will support to homogeneous seismic source zone definition for Greece and the eastern Mediterranean region (WP3).

**Asst. Professor Nicholas VOULGARIS** (Seismology, Geophysics Department, University of Athens) will participate. His main scientific interests are engineering seismology and earthquake hazard. He will contribute to homogeneous seismic source zone definition for Greece and the eastern Mediterranean region (WP3).

**Assoc. Professor Vassiliki KOUSKOUNA** (Seismology, Geophysics Department, University of Athens) will participate. Her main scientific interests are historical seismology, macroseismology, and seismic hazard. She will participate in homogeneous historic data collection for Greece and the eastern Mediterranean region (WP3).

–**NORSAR-ICG** – NORSAR/International Centre for Geohazards, Norway

NORSAR (www.norsar.no) was established in 1968 as a joint undertaking between the Norwegian and the United States governments, with the primary purpose is to conduct research of seismological problems relevant to the detection and identification of earthquakes and underground nuclear explosions. From 1970 to 1999, the Norwegian Research Council administered NORSAR; it became an independent research foundation in 1999, with the status as a Norwegian research institute in the area of natural sciences and technology. While the primary purpose of NORSAR is verification seismology, it also conducts research, development and consulting within various fields of seismology and applied geophysics. NORSAR has 40 years of experience with advanced seismological processing and data analysis techniques, and its scientists have published more than 1000 papers and reports.

NORSAR has been a main contributor to the technology implemented at the International Data Centre (IDC) in Vienna for verification of the Comprehensive Nuclear Test Ban Treaty (CTBT). NORSAR's scientists were instrumental in developing the concept of regional seismic arrays in the 1980's, a technology that today constitutes a backbone in the International Monitoring System (IMS). The basis for these efforts has been the establishment and operation by NORSAR of a number of seismic arrays in Norway and at Svalbard, and in addition NORSAR has participated in establishing and/or operating several arrays in many other countries. NORSAR has also been engaged in design, installation and operation of a number of seismic monitoring networks.

NORSAR has since 1975 conducted more than 150 earthquake hazard related projects in Norway and other countries, including both research projects and site specific and regional zonation studies. The targeted facilities include nuclear and hydroelectric power plants, dams, tunnels, waste facilities, offshore platforms and pipelines, and petrochemical facilities. Recently this has been extended to include also tsunami hazard as well as earthquake risk, in a number of countries. NORSAR has also been engaged in seismic zonation projects for building code purposes both in mainland Norway and offshore, and one of its scientists have for many years been a member in the Norwegian Code Commission, with engagements that also includes the adaptation of Eurocode 8 to Norwegian conditions.

NORSAR is a partner in the International Centre for Geohazards, ICG (www.geohazards.no), a Norwegian Centre of Excellence established by the Research Council of Norway.

The main participants from NORSAR in this project will be **Dr. Conrad LINDHOLM** and **Dr. Hilmar BUNGUM**. Dr. Lindholm is currently Program Manager for a group on Earthquakes and the Environment, with responsibility for a number of national and international projects within earthquake hazard and risk. Dr. Lindholm has extensive project management experience, also internationally, and he has published a large number of papers and reports. Dr. Bungum is a senior scientist with an extensive record in administrative responsibilities, project management experience, and scientific publications (135 papers, 190 reports). Dr Bungum has been an adjunct professor in geophysics at the Universities of

Bergen and Oslo, and he has also been a long-term member of the Seismic Code Commission for Norway.

**Dr. Hilmar BUNGUM** will co-lead earthquake data collection and seismic source zones for Scandinavia and polar areas (WP3).

–**ROB** – Royal Observatory of Belgium, Belgium

The Royal Observatory of Belgium is a Belgian federal scientific institution, created in 1826, and covering a large field of activities in Astronomy, Astrophysics and Physics of the Earth. To maintain exact national references for time, positioning and gravity, and to integrate them in internationally accepted global reference systems are among fundamental missions of the ROB.

The section of Seismology staffs 12 scientists and 7 technicians. This section is responsible for the monitoring of seismic activity in Belgium with a network of 24 permanent seismic and 17 accelerometer stations. Our scientific activities are related to the study of the seismic cycle, covering a broad part of earthquake seismology: instrumental and historical seismology, active faulting and associated paleoseismology investigations, gravimetry and tectonic geodesy. These investigations concern mainly Western Europe, but also the western branch of the East African Rift, Bulgaria and Turkey. Our group of scientists was involved in two European projects related to active fault studies: it coordinated the project PALEOSIS (1998-2000) and was one of the leading groups in the project SAFE (2001-2004). Since 2006, it hosts a Marie Curie Excellence Grant Project that is investigating the seismic cycle in Turkey.

The group is also responsible for the evaluation of seismic hazard in the framework of Eurocode 8 and for the sitting of weakly radioactive waste disposal in northern Belgium.

**Dr. Pierre ALEXANDRE** is an historian, specialist of the history of natural phenomena, mainly historical seismicity and climate. His book on earthquakes in Western Europe from 394 to 1259 is one of the most famous sources of information to establish reliable earthquake catalogues in Europe for this time period. He will provide his experience on historical criticism to the establishment of the European earthquake catalogue. He will contribute to the collection of historical earthquake data and seismic source zone definition (WP3).

**Dr. Thierry CAMELBEECK** is acting head of the section seismology of the ROB. He contributes to a better knowledge and understanding of the seismic activity in northwest Europe, by integrating information from the present-day earthquake activity, historical seismicity and paleoseismology. He will provide his expertise in the establishment of the catalogue of earthquakes and seismogenic sources, and also for the definition of the source zones for the hazard evaluation in Western Europe. He will co-lead the efforts of ROB for the data collection in central-western Europe in cooperation with GFZ.

**Dr. Kris VANNESTE** developed methodologies to identify and study active faults in intraplate tectonic contexts (northwest Europe, Bulgaria, central Africa, Turkey) using geomorphology, shallow geophysics and paleoseismic investigations. He will participate to the inventory of seismogenic sources in Western Europe. He will contribute to the earthquake data collection and seismic source zone definition from the geological perspective in WP3.

### *B.2.3 Consortium as a whole*

The SHARE consortium is a well-balanced combination of the leading European research institutions in the field of seismic hazard assessment and engineering seismology and of governmental institutions concerned with regulatory issues. In combination with the participation of internationally renowned experts, the composition of the SHARE consortium delivers the comprehensive expertise to implement the required pan-European framework for seismic hazard harmonization.

***Sub-contracting respectively consultancy***

Costs and usage of subcontracts are specified for the beneficiaries that have allocated money for subcontracts. These costs are specified accordingly in the Tables a-c in section B.2.4.

**SED-ETHZ** allocates costs for a sub-contract specifically for an auditing fee charged by the consultancy company in charge of required procedures for EU-audits. The costs for the financial audit are €1500.

**INGV** will secure the expertise in statistical seismology of the University of Bologna through a sub-contract, for the characterization of seismic sources from historical macroseismic information. The amount of €30000 is dedicated to research work on quality assessment of the seismic source characterization and covers travel costs for workshops in WP3.

**UPAV** will be in charge of WP7, focusing on the dissemination of SHARE results outside of the SHARE Consortium. To accomplish this goal, it will rely on the proven expertise of Geodeco SpA, a SME based in Genova (Italy) specialized as consultant in risk assessment projects and in developing web tools and interface for the engineering community and the general public. UPAV allocates €50000 for the subcontract to Geodeco SpA to ensure high standards and visibility of the SHARE products during the project and after the end of the project.

**IST** will be responsible for the WP3 work involving the Ibero-Maghreb region. Part of the work in that region will be undertaken via a subcontract to the University of Madrid for reports on active tectonics in Spain. The subcontract of €20000 will ensure coordination of research and data collection from Spain and cover travel costs for workshops of the experts from the University of Madrid.

Transparent subcontracting procedures will be implemented according to the rules.

***Third parties***

The following third parties are linked to Universit Joseph Fourier Grenoble 1 (UJF) / Laboratoire de Géophysique Interne et Tectonophysique (LGIT)

- Centre National de la recherche Scientifique (CNRS)
- Université de Savoie
- Laboratoire Central Ponts et Chaussées (LCPC)
- Institut de Recherche pour le Développement (IRD)

Univ. Joseph Fourier Grenoble 1 may transfer its foreground the third parties mentioned below :

*Céline Beauval(IRD), Pierre-Yves Bard and Philippe Guéguen from LCPC acting as third parties to UJF, will work on the following work packages:*

- *IRD : WP5 'Seismic hazard assessment and WP4 : 70.000 Euro.*
- *LPCP WP4-,'Strong ground motion modelling, task 4.3, 4.4;: 90.000 Euro*

*The EC contribution for this personnel staff is estimated to 160 000 €.*

## *B.2.4 Resources to be committed*

### *B.2.4.1 SHARE resource plan*

The plan of resources to be mobilized for SHARE covers five main types of resources.

***EC contribution to SHARE***

The resources contributed by the EC will support all the direct expenses, travel and personnel of the participants to ensure the harmonization of hazard input, methodologies and results.

***Contribution of background and expertise to SHARE***

In addition to the resources specifically supported under the EC contribution, the SHARE participants will make available expertise, human resources, computing infrastructures and technical personnel to the project. Indeed, the resources acquired in SHARE will serve as common resources to bring together the vast expertise and knowledge accrued in numerous national programs, scientific knowledge developed in the academic environment and the knowledge developed in previous regional and European projects. As such, many participating institutions will make available resources matching those to be supported by the EC.

In addition, a larger community of experts will participate in building the regional databases and input models for SHARE. Dedicated travel and workshop support is built in SHARE, for a total of €350,000, showing the importance that SHARE assigns to involving the wider technically informed community in the project.

***Additional projects directly contributing to SHARE***

Two on-going projects will contribute directly to SHARE and coordinate their agenda with SHARE:

– The Balkans project (Harmonization of seismic hazard maps for the Western Balkan Countries, SfP Project 983054, www.seismo.cg.yu) will cover the development of hazard in six Balkans countries. The inclusion of MSO (the Balkans coordinator) as SHARE participant will ensure optimal coordination. Resources in SHARE and Balkans will be joined to ensure the harmonization of input and hazards across the whole area.

– The project ALGERIA - Capacity building in earthquake surveillance and information in Algeria, supported by the Swiss Agency for Development and Cooperation (www.sdc.admin.ch/en/Home), will support the coordination of hazard assessment in Algeria and includes funding for a regional workshop on seismic hazard in the Maghreb countries (including Morocco, Tunisia and Libya).

***Project computational infrastructure***

The computational infrastructure will be built at SED-ETHZ and supported largely by the EC contribution. In addition, SED-ETHZ will contribute its expertise in data management, system management, IT technologies, web tools, scientific programming and software engineering.

***Project management***

It will be provided by SED-ETHZ and supported largely by the EC contribution. Where required, SED-ETHZ will contribute additional administrative and web support.

### *B.2.4.2 Resources provided by participants*

The resources listed in this section provide a detailed overview on the person-months committed to use the EC contribution during the project. This is linked to the Project Effort Forms 1 and 2.

A breakdown for the usage of "Other direct costs" is detailed in the Tables A, B and C at the end of this section. For the coordinator, beneficiaries leading a work package and beneficiaries coordinating data collection, we allocated direct costs for organizing workshops including expenses for consultants and external experts under "Workshops / Meetings". Details are described below and in the Work package description (section B1.3.5).

**SED-ETHZ** will manage SHARE and contribute 36 months of project manager (70%) and project office (administrative (15%) and financial (15%) assistance); it will use 2 researcher-months to WP2-4 to ensure the coordination in the definition of the engineering requirements and the development of the earthquake input data and of the ground motion model; it will lead WP6 and allocate 36 month of software engineer, database management, IT support and scientific programming toward the development of the SHARE computational infrastructure; it will assign 9 researcher-months for the coordination of the whole hazard assessment process in WP5, and 3 month toward the implementation of a comprehensive strategy of dissemination; it will provide the official link to NERIES, SAFER, GEM/OECD and to the European Seismological Commission. SED-ETHZ allocated costs to organize workshops in WP6, to coordinate and organize the meetings of the General Assembly and the management committee (WP1).

**GFZ** will allocate 22 months of researcher to coordinate the WP3 data collection and SSZ definition in Central Europe, for the homogenous assessment of earthquake statistics, for the calibration of a homogeneous European earthquake catalogue and for the overall coordination in the definition of SSZ for the whole Europe; it will lead WP5 and assign 24 researcher-months to ensure overall coordination and harmonization across the whole hazard assessment process. GFZ assigns costs for organizing workshops in WP5.

**INGV** will lead WP3 and use 52 researcher-months to ensure overall coordination to all activities related to earthquake data collection, characterization of active faults and seismogenic structures, definition of the reference strain-rate models and SSZ definition for the whole Europe; it will assign 2 researcher-months for the coordination of the whole hazard assessment process in WP5, 1 month for coordinated development of the WP6 infrastructure and 4 months for the implementation of the dissemination strategy; INGV will manage the sub-contract with University of Bologna for macroseismic source characterization schemes. INGV allocates costs for organizing periodic meetings and activate regional experts to homogenize data collection and harmonization (WP3).

**LGIT-UJF** will lead WP4 and allocate 39 researcher-months to the definition of the European ground motion model, 2 months to the definition of the engineering requirements (WP2) and 2 month to the coordination of the whole hazard process in WP5; LGIT-UJF will manage external expert participation in the working group for the definition of the ground motion model. LGIT-UJF will organize periodic meetings and lead expert elicitation for WP4.

**UPAV** will lead WP2 and assign 52 researcher-months to the coordination of the engineering requirements and of risk scenario modelling, 2 month to the coordination of the whole hazard process in WP5 and 1 month for coordinated development of the WP6 infrastructure; it will lead WP7 and allocate 4 month to the definition and implementation of a wide-ranging dissemination strategy; UPAV will manage the sub-contract with Geodeco SpA for the development of web interfaces for product dissemination in WP7. For WP2, UPAV will bring together engineering experts to workshops (WP2) coordinated with LNEC.

**AUTH** will use 12 researcher-months for the engineering requirements and the characterization of site effects in WP2, 7 months to coordinate the WP3 data collection and SSZ definition in the Aegean and Eastern Mediterranean, and 6 months to participate in the definition of the site conditions in the strong motion model.

**BRGM** will allocate 4 researcher-months to the definition of the ground motion models and 9 months to the development of web-based tools for the SHARE portal.

**CRAAG** will link the ALGERIA SDC project and will commit 11 researcher-months to coordinate the WP3 data collection and SSZ definition in the Maghreb region.

**IST** will assign 12 months to coordinate the WP3 data collection and SSZ definition in the Ibero-Maghreb region and the central Atlantic area, including the Azores; IST will manage the sub-contract with University of Madrid for the regionalization of the Ibero-Maghreb region. IST will organize workshops on the data collection within the Ibero-Maghreb region (WP3).

**KOERI** will devote 4 researcher-months for the definition of engineering requirements and for risk scenario simulations for Istanbul in WP2, 10 months to coordinate the WP3 data collection and SSZ definition in the Aegean and Eastern Mediterranean area, and 4 months for the definition of the strong motion model in WP2.

**LNEC** will provide the official link and coordinate the joint workshops with the EC8 Committee CEN/TC250/SC8 (WP2), and will use 12 researcher-months to the definition of the engineering requirements and to the risk scenario simulations for Lisboa.

**METU** will play a major role and lead several tasks in WP4, and will commit 37 months of researcher and graduate students toward the definition of the reference ground motion model for Europe.

**MSO** will link with the NATO SfP Balkans project through a workshop (WP3) and allocate 1 researcher-month to the definition of the engineering inputs in WP2, 5 months to coordinate the WP3 data collection and SSZ definition in the Balkan area, in cooperation with NIEP, and 1 month for the definition of the ground motion model.

**NERC-BGS** will assign 13 researcher-months to coordinate the WP3 data collection and SSZ definition in the offshore areas of the Atlantic, and to the harmonized determination of activity rates for the whole Europe. NERC-BGS allocates costs to workshops jointly with NORSAR/ICG (WP3) for data collection and seismic source zone definition.

**NIEP** will devote 15 researcher-months to coordinate the WP3 data collection and SSZ definition in Eastern Europe and the Balkan area, in cooperation with MSO.

**NKUA** will use 8 researcher-months to coordinate the WP3 data collection and SSZ definition in the Aegean and Eastern Mediterranean area.

**NORSAR-ICG** will commit 14 researcher-months to coordinate the WP3 data collection and SSZ definition in Scandinavia and the polar region, and to the harmonized determination of activity rates for the whole Europe. NORSAR/ICG allocates costs to workshops jointly with NERC-BGS (WP3) for data collection and seismic source zone definition.

**ROB** will assign 7 researcher-months to coordinate the WP3 data collection and SSZ definition in Central Europe. ROB will organize workshops on data collection and SSZ definition for Central Europe.

| | SED-ETHZ | GFZ | INGV | LGIT_UJF | UPAV | AUTH |
|---|---|---|---|---|---|---|
| Cost category | | | | | | |
| RTD activity | | | | | | |
| Personnel cost | 194,145.83 | 200,666.67 | 222,083.33 | 198,510.00 | 216,666.67 | 89,666.67 |
| Subcontract | 0.00 | 0.00 | 30,000.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | |
| Detail direct cost | | | | | | |
| Equipment | | | | | | |
| Consumables | | | | | | |
| Travel | 15,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 |
| Publication | | | | | | |
| Workshop / Meeting | 40,000.00 | 27,000.00 | 45,000.00 | 58,990.00 | 20,000.00 | |
| Sub-total Other Direct Costs | | | | | | |
| Total direct costs w/o salary | 55,000.00 | 37,000.00 | 55,000.00 | 68,990.00 | 30,000.00 | 10,000.00 |
| Overheads | 149,487.50 | 142,600.00 | 166,250.00 | 160,500.00 | 148,000.00 | 59,800.00 |
| Total | 398,633.33 | 380,266.67 | 473,333.33 | 428,000.00 | 394,666.67 | 159,466.67 |
| | | | | | | |
| Management & Other activity | | | | | | |
| Personnel cost | 180,500.00 | 0.00 | 8,250.00 | 0.00 | 13,750.00 | |
| Subcontract | 1,500.00 | 0.00 | 0.00 | 0.00 | 50,000.00 | |
| | | | | | | |
| | | | | | | |
| Equipment | | | | | | |
| Consumables | 10,000.00 | | | | | |
| Travel | 10,000.00 | | | | | |
| Publication | | | | | | |
| Workshop / Meeting | 31,062.50 | | | | | |
| Sub-total Other Direct Costs | | | | | | |
| Total direct costs w/o salary | 233,062.50 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Overheads | 138,937.50 | | 4,950.00 | | 8,250.00 | |
| Total | 372,000.00 | | 13,200.00 | | 72,000.00 | |

**Table A:** Breakdown of budget for beneficiaries 1-5 for 36 months.

| | BRGM | CRAAG | IST | KOERI | LNEC | METU |
|---|---|---|---|---|---|---|
| Cost category | | | | | | |
| RTD activity | | | | | | |
| Personnel cost | 89,300.00 | 34,444.44 | 48,810.80 | 81,666.67 | 49,166.67 | 105,000.00 |
| Subcontract | 0.00 | 0.00 | 20,000.00 | 0.00 | 0.00 | 0.00 |
| | | | | | | |
| Detail direct cost | | | | | | |
| Equipment | | | | | | |
| Consumables | | | | | | |
| Travel | 14,300.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 |
| Publication | | | | | | |
| Workshop / Meeting | | | 20,000.00 | | 40,000.00 | |
| Sub-total Other Direct Costs | | | | | | |
| Total direct costs w/o salary | 14,300.00 | 10,000.00 | 30,000.00 | 10,000.00 | 50,000.00 | 10,000.00 |
| Overheads | 67,900.00 | 8,888.89 | 47,855.87 | 55,000.00 | 59,500.00 | 69,000.00 |
| Total | 171,500.00 | 53,333.33 | 146,666.67 | 146,666.67 | 158,666.67 | 184,000.00 |
| | | | | | | |
| Management & Other activity | | | | | | |
| Personnel cost | | | | | | |
| Subcontract | | | | | | |
| | | | | | | |
| | | | | | | |
| Equipment | | | | | | |
| Consumables | | | | | | |
| Travel | | | | | | |
| Publication | | | | | | |
| Workshop / Meeting | | | | | | |
| Sub-total Other Direct Costs | | | | | | |
| Total direct costs w/o salary | | | | | | |
| Overheads | | | | | | |
| Total | | | | | | |

**Table B:** Breakdown of budget for beneficiaries 6-11 for 36 months.

| | MSO | NERC-BGS | NIEP | NKUA | NORSAR | ROB | Total |
|---|---|---|---|---|---|---|---|
| Cost category | | | | | | | |
| RTD activity | | | | | | | |
| Personnel cost | 21,666.67 | 64,166.67 | 61,111.11 | 31,666.67 | 83,600.00 | 33,666.67 | 1,826,005.52 |
| Subcontract | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 50,000.00 |
| | | | | | | | |
| Detail direct cost | | | | | | | |
| Equipment | | | | | | | |
| Consumables | | | | | | | |
| Travel | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 10,000.00 | 189,300.00 |
| Publication | | | | | | | |
| Workshop / Meeting | 10,000.00 | 10,000.00 | | | 10,000.00 | 10,000.00 | 290,990.00 |
| Sub-total Other Direct Costs | | | | | | | |
| Total direct costs w/o salary | 20,000.00 | 20,000.00 | 10,000.00 | 10,000.00 | 20,000.00 | 20,000.00 | 480,290.00 |
| Overheads | 25,000.00 | 75,750.00 | 14,222.22 | 25,000.00 | 43,066.67 | 14,311.11 | 1,332,132.26 |
| Total | 66,666.67 | 134,666.67 | 85,333.33 | 66,666.67 | 146,666.67 | 85,866.67 | 3,681,066.69 |
| | | | | | | | |
| Management & Other activity | | | | | | | |
| Personnel cost | | | | | | | 202,500.00 |
| Subcontract | | | | | | | 51,500.00 |
| | | | | | | | |
| | | | | | | | |
| Equipment | | | | | | | |
| Consumables | | | | | | | |
| Travel | | | | | | | 10,000.00 |
| Publication | | | | | | | |
| Workshop / Meeting | | | | | | | 31,062.50 |
| Sub-total Other Direct Costs | | | | | | | |
| Total direct costs w/o salary | | | | | | | 233,062.50 |
| Overheads | | | | | | | 152,137.50 |
| Total | | | | | | | 457,200.00 |

**Table C:** Breakdown of budget for beneficiaries 12-18 for 36 months.

# B.3 Impact

## *B.3.1 Strategic impact*

SHARE responds to all the priorities and expected impacts defined by the call ENV.2008.1.3.1.1, and will secure measurable progress beyond the state-of-the-art in all steps leading to a correct assessment of seismic hazard – 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.

***Impact for the implementation of Eurocode 8 and for safe building construction practice in Europe***

–The key aim of ENV.2008.1.3.1.1 is to "contribute to a homogeneous application of the Eurocode 8 through harmonizing methodologies for seismic hazard zonation in Europe". By working closely with CEN/TC250/SC8, SHARE will develop the tools to facilitate the harmonization of the Nationally Determined Parameters to be defined in the National Annexes to EN 1998.1. We will achieve this by involving the relevant national experts in regional assessment of hazard, by adopting common European standards, and by producing a pan-European reference zonation of the anchoring variable for the definition of the national seismic zonation maps (peak acceleration on rock). This will result in more homogenous input for the implementation of the Eurocode 8 in 2010 and following years.

–In parallel, SHARE will explore several ways to improve input specifications for the Eurocode 8, with specific reference to the "most appropriate return periods and ground-motion parameters for design for built environment for ultimate and damage-limit states". To this end, we will (1) provide the basis to fully incorporate the principles of Performance-Based Seismic Design in the next generation of seismic design codes; (2) develop seismic hazard models capable of readily and more accurately providing earthquake actions in ways that are appropriate to the estimation of inelastic displacements, since these provide an effective control on damage at different limit states; (3) present alternative proposals to the current practice of defining the loading levels on the basis of pre-selected, and somewhat arbitrary, return periods; (4) explore alternative spectral shapes and site effect classifications; and (5) derive alternative parameters to characterize seismic input.

–SHARE will cover all of the countries of Europe and of large parts of the Mediterranean, including Turkey and the countries of the Balkan area and of the Maghreb. This will result in the harmonization of the input zonations for the application of Eurocode 8 and ultimately in safer building construction practice in the whole Euro-Mediterranean region.

***Impact for risk assessment for critical infrastructures and the insurance sector***

–A declared priority of ENV.2008.1.3.1.1 is to improve the conditions for seismic hazard assessment for industry in Europe, and to provide a uniform framework for coherent PSHA for various applications. SHARE will achieve this goal, by developing a uniform pan-European understanding of low-probability earthquake hazard, by adopting hazard assessment methodologies and QA procedures consistent with those used in specific hazard studies for critical infrastructures sites, and by concentrating efforts in the coherent assessment of uncertainties. This uniformity in procedure will allow users to couple their site-specific studies consistently to a pan-European reference model, which will allow for more consistent regulations and licensing procedures in the energy industry and more generally in the critical infrastructure sector. This is of particular relevance today, as new strategies for future energy sustainability are being developed, with an important role foreseen for the nuclear and geothermal power.

–SHARE will produce homogeneous reference European-wide hazard mapping at different return periods, suitable for implementation in portfolio risk assessment in the re-insurance and insurance industry, and potentially leading to the definition of a pan-European strategy to insure our society from earthquake losses. The long-term goal is indeed to enable local administrators and policy makers to become more aware of the local seismic risk and to quantify the potential effectiveness of implementing a seismic mitigation program, or enforcing obligatory earthquake insurance or issuing a national catastrophe bond that would provide immediate post-event liquidity.

***Impact for European participation in the Global Earthquake Model program initiated by the OECD***

–With SHARE, Europe will set up a framework for harmonized assessment of seismic hazard and risk. SHARE will also enable European participation and leadership in the new Global Earthquake Model program initiated by the OECD, which aims to improve the assessment of seismic risk so that adequate earthquake risk mitigation measures may be implemented in developing countries. With SHARE, Europe will assemble the necessary scientific and technical expertise and infrastructure to play a major role in setting up and implementing GEM.

***Impact for harmonization of hazard input, output, and assessment methodologies***

– SHARE will build a framework for integration across disciplines, by involving participants, competences and experts spanning all fields from earthquake engineering to geology to engineering seismology, and for integration across national borders, to compile earthquake data and assess seismic hazard without the burden of political constraints and administrative boundaries. An authoritative community model will be assembled by seeking extensive expert elicitation and participation and through community feedback. By incorporating the best European technical and regional expertise in all disciplines required for a modern assessment of seismic hazard, by having national experts participating in building regional consensus models, by transcending the traditional administrative and disciplinary boundaries, and by formally eliciting expert opinions, SHARE will achieve a long-lasting level of harmonization which cannot be obtained when working only at national level.

– SHARE will deliver the most reliable and homogeneous seismicity dataset at the European scale, for applications in all sectors of risk analysis.

– By delivering the first consensus model of ground motion attenuation on rock for the Euro-Mediterranean region, together with site corrections calibrated for regional applications, SHARE will set the standard for the future unification of ground-motion models across Europe, moving away from national products.

– SHARE will incorporate the latest scientific and engineering knowledge, including the use of geological and geodetic constraints in the assessment of strain rates; Next Generation Attenuation models; the systematic assessment of site conditions for strong-motion records and stations; first attempts of simulation-based hazard in complex tectonic environments; coverage of ocean and polar regions; full treatment of aleatory and epistemic uncertainties; formal expert elicitation procedures; and a logic tree representation of the whole hazard model. The high technical level of the input and output requirements will set a new standard for national hazard assessment across Europe.

– By implementing a comprehensive treatment of both aleatory and epistemic uncertainties in a logic tree formulation, SHARE will ensure the assessment of realistic mean hazard results. We expect that the SHARE logic tree model will become in itself a standard for European applications at different scale.

– SHARE will enable substantial overall progress in European seismic hazard modeling by installing a controlled computational infrastructure that may be adapted for other projects. This will include formalizing and harmonizing all steps in hazard input data preparation, in the definition of input files and of interfaces between the different groups delivering inputs for hazard computation, and in the validation of the results.

– SHARE will ensure the open availability and dissemination of data, tools and products, through a dedicated Portal, with the aim of reaching the wider technical community and the public

## *B.3.2 Plan for the use and dissemination of foreground*

SHARE will ensure the distribution and exploitation of results at all levels. Dissemination mechanisms have been built in the project structure, a dedicated portal will be built and a full work package (WP7) is introduced with the declared goal of enabling dissemination and exploitation of databases, results and tools developed by SHARE.

***Dissemination to the scientific and earthquake engineering communities participating in SHARE***

The structure and mechanisms in WP3 and WP4 ensure that not only the participants in SHARE, but the larger European community of national and technical experts will participate in SHARE and be exposed to results and procedures. Based on the past experience of the SESAME/ESC project, we expect that over 150 scientists will directly participate in SHARE.

Activities in WP3 cover the collection and elaboration of earthquake data. In order to ensure geographical completeness, the work will proceed in predefined regions, covering the whole Euro-Mediterranean region (in this phase, our coverage of the Mediterranean includes the Maghreb countries to the West, and extends to Turkey to the East, excluding the Near-East and Red-Sea areas), and will be supported by key institutions acting as regional coordinators responsible for homogeneous data collection and interpretation. The work in the individual regions will take place through dedicated workshops, where experts from all countries in the region will convene to compile relevant data and models to be considered in assembling the regional models. Two workshops are foreseen for each region, for the compilation of the datasets and the evaluation of the seismic source models. A final workshop at European scale will then be conducted during the validation phase to evaluate the results of the hazard modeling. These structure and procedures will ensure the integration and harmonization of the results of the individual regions and the dissemination of knowledge, databases and models at the Euro-Mediterranean scale.

The core of WP4 is the definition of a reference European model of strong ground motions. The work will be conducted along three integrated hierarchical levels: (1) a restricted team of investigators will coordinate the expert elicitation, carry out the data collection and model generation, and coordinate the technical specifications with the engineering requirements expressed in WP2; (2) a core group of renowned European and global experts will assist the work of the WP4 investigator team, cooperating in the definition of the specifications and in the model selection; and (3) a wider consensus will be established through a European-wide meeting of experts from engineering seismology and earthquake engineers. We anticipate that the large majority of the European technical community will become involved in the second and third steps of this process, ensuring the pan-European dissemination and long-term use of the SHARE results and knowledge.

***Dissemination to the Eurocode 8 community***

This will be ensured by the compatibility of the SHARE hazard output specifications with the Eurocode 8 application requirements. We will conduct annual review meetings jointly with the annual meetings of the CEN/TC250/SC8 Committee (LNEC hosts the Secretariat of the Eurocode 8 Committee). A first meeting will serve to draft a hazard output specification requirement document; a second meeting to report progress, a third meeting to review and validate the hazard products. Hazard output specifications will include ground-motion parameters, damping, return periods, frequencies and all other specifications to ensure that the pan-European seismic hazard results can be applied to improve and harmonize the Nationally Determined Parameters in the national code applications.

***Exploitation by the wider engineering and industry community***

SHARE will create a specific Portal to disseminate seismic hazard results. As example of the portal functionalities, users will be able to select a given location and obtain hazard in terms of response spectrum but also acceleration time-histories whose elastic response spectra match the design spectrum at the site of interest (i.e., scaled for hazard level, site class and other parameters). The Portal will also provide expert users Web access to the SHARE computational engine to extract user-specific hazard products; for example, such a user could specify a map location, rock type, earthquake rate model, and time window, and generate the applicable hazard curves.

***Dissemination to the external scientific community***

SHARE project partners will disseminate to the scientific community information on and results from the project via presentations at appropriate national and international meetings and peer-reviewed publications.
We also envision taking the following approaches to spread information to scientific users:

– the publication of a periodic electronic newsletter presenting the on-goings of the project;

– the presentation of the project and approved results in the public area of the SHARE web-portal;

– the organization of special sessions of International Congresses dedicated to seismic hazard and risk assessment (e.g. European Geophysical Union Meeting 2009, European Seismological Commission Meeting 2009);

– the establishment of specific Working Groups within the European Seismological Commission formed by the WP3-4-5 participants, in order to embed SHARE in the larger scientific and technical community.

***Dissemination to developing countries***

SHARE will disseminate its tools and results to developing countries by establishing the SHARE hazard computational facility as one of the regional nodes of the Global Earthquake Model program, initiated by the OECD, and offering the possibility to partner with developing countries (i.e. the African Rift countries) and to transfer the SHARE methodologies and knowledge.

***Dissemination of results and recommendations to policymakers and stakeholders***

One of SHARE's principal goals is to produce methods and products that be readily employed in the updating of building codes such as Eurocode 8. In order to ensure our products may be effectively used by policymakers, industry, and related groups, we anticipate:

I. inviting policymakers and stakeholders to take part in plenary and/or WP meetings;
II. the production of tailored documentation (e.g. hard-copy brochures or reports) aimed at communicating the results of the projects in a way that is consistent with such target audience;
III. the organisation of targeted workshops aimed at increasing the awareness of these specific end-users to the pertinence and value of achieved outcomes;
IV. the publication of a new map of seismic hazard for the Euro-Mediterranean territory, for distribution to public offices, schools, education institutions and the interested public.

***Dissemination of results toward other related projects and initiatives***

With the overall goal to stimulate the growth of a wide technical hazard community in Europe, beyond national or project boundaries, SHARE will interact closely with other national and international projects, such as NERIES, LESSLOSS and SAFER, to share information, build on existing expertise, facilitate the transfer of knowledge (from already completed projects) and the triggering of collaboration initiatives (with projects still running).

***Dissemination of results toward the general public***

It is important to ensure that the general public is not only aware of the level of seismic hazard to which it may be exposed to, but also of the commitment of scientific/professional communities, policymaking bodies, European Commission, etc, in mitigating earthquake-related risks. As such, advantage will be taken from not only the accumulated experience in such type of public awareness raising activities (e.g. preparation of material adequate for distribution in schools, organisations of public visits to research centres, organisation of press conferences, etc) but also of the existing association of the coordinator of this work package with a media communications venture (Segni & Suoni) specialised in the feeding of press releases to printed, audio and audiovisual media organisations.

**Management of intellectual property**

SHARE will maintain a clear separation between the intellectual property generated by the project and the pre-existing knowledge created by on-going and past projects at all levels in Europe, which will be used to compile the regional databases used for the SHARE hazard assessment. The IP management in SHARE will follow this differentiation.

–SHARE will produce relational databases to contain the input data required for the seismic hazard assessments. The four primary databases cover: (1) seismic source zones, maximum magnitudes and earthquake activity rates; (2) ground-motion models and site effects; (3) synthetic earthquake catalogues; and (4) logic trees governing hazard estimates. All the regional databases created for SHARE will be available freely on the SHARE portal, following suitable validation.

−The full hazard results and the SHARE computational engine will be available freely on the SHARE portal, following suitable validation.

−All primary input datasets (such as the individual catalogues used to assemble the reference European catalogue) will be available at the institutes that generated them, and a comprehensive meta-database will be maintained by SHARE to allow users to access the primary data. Most of these primary databases will be also freely available by the owning agencies, and this availability will be indicated in the SHARE meta-database.

## B.4 Ethical Issues

A commitment to achieve the highest range of knowledge concerning possible causes of man-made disasters or induction or triggering of natural disasters by means of human activity is an expression of a society's demand for reliable sources of information on the range and effects of its industrial, technical and scientific activity; it is a hallmark of integrity in research and reflects a drive for honesty and transparency within the political, economic and social sphere. SHARE's contribution towards achieving such lofty goals is, in itself, a stepping-stone towards ethical progress in science and technology. We are fully in line with the Principle of responsibility the way Hans Jonas has defined it.

The consortium has thoroughly investigated the Charter of Fundamental Rights of the European Union, Ethical rules of the Fifth Framework Programme, Conventions of the Council of Europe, Universal Declaration of UNESCO, the Helsinki Declaration of the World Medical Association, the bulletins of the European Group on Ethics in science and new technologies, several national regulations and international codes of conduct, among other legislative and normative materials with respect to possible ethical concerns. The proposed Collaborative project **does not** raise any sensitive ethical questions related to human beings, human biological samples, genetic information, or ethical concerns related to animals. Additionally, it is hereby stated and confirmed that the proposed research **does not** involve:

- Research activity aimed at human cloning for reproductive purposes.
- Research activity intended to modify the genetic heritage of human beings which could make such changes heritable
- Research activity intended to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer.
- Research involving the use of human embryos or embryonic stem cells with the exception of banked or isolated human embryonic stem cells in cultures.

Accordingly, Directive 2001/20/EC of the European Parliament and of the Council of 4 April 2001, the Council Directive 83/570/EEC of 26 October 1983 amending Directives 65/65/EEC, 75/318/EEC and 75/319/EEC, the Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998, the Directive 90/219/EEC of 23 April 1990, Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 are not applicable. Personal data – whether identified by name or not – will not be collected nor processed. Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data is therefore also not applicable. As for the foreseeable future, **no special ethical requirements** can be stated in the scope of the hereby-described Collaborative project. In summation, the following table is true and accurate for all activities of all work packages contained in the SHARE proposal.

## ETHICAL ISSUES TABLE

| | YES | NO |
|---|---|---|
| **Informed Consent** | | |
| • Does the proposal involve children? | | **NO** |
| • Does the proposal involve patients or persons not able to give consent? | | **NO** |
| • Does the proposal involve adult healthy volunteers? | | **NO** |
| • Does the proposal involve Human Genetic Material? | | **NO** |
| • Does the proposal involve Human biological samples? | | **NO** |
| **Research on Human embryo/foetus** | | |
| • Does the proposal involve Human Embryos? | | **NO** |
| • Does the proposal involve Human Foetal Tissue/Cells? | | **NO** |
| • Does the proposal involve Human Embryonic Stem Cells? | | **NO** |
| **Privacy** | | |
| • Does the proposal involve processing of genetic information or personal data (e.g., health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction) | | **NO** |
| • Does the proposal involve tracking the location or observation of people? | | **NO** |
| **Research on Animals** | | |
| • Does the proposal involve research on animals? | | **NO** |
| • Are those animals transgenic small laboratory animals? | | **NO** |
| • Are those animals cloned farm animals? | | **NO** |
| • Are those animals non-human primates? | | **NO** |
| **Research involving Developing Countries** | | |
| • Use of local resources (genetic, animal, plant, etc.) | | **NO** |
| • Impact on a local community | | **NO** |
| **Dual Use and potential for terrorist abuse** | | |
| • Research having direct military application | | **NO** |
| • Research having the potential for terrorist abuse | | **NO** |
| **I CONFIRM THAT NONE OF THE ABOVE ISSUES APPLY TO MY PROPOSAL** | **YES** | |

# B.5 Consideration of gender aspects

## *B.5.1. General aspects of gender issues and relevance in the proposed research*

Basically, the analysis of possible gender relevance has to take into consideration the possible impact on one or more different distinctive population groups, or on the daily life of distinguished parts of the population. On the other hand, significant criteria could arise from the question of whether differences between women and men with respect to risks and rights, resources, participation, values and standards. Within the fields of seismology and geothermal engineering, neither a specified analytical approach nor data are available. As no cognitive dimension offering proof of a possible gender or group relevance of the proposed research work exists, the question whether or not gender issues are involved has to be negated.

## *B.5.2. Action Plan to Promote Gender Equality*

Concerning the implementation of measures in a gender action plan, the consortium strongly supports the European initiatives underway to promote gender equality, notably the EQUAL community initiative programme, as well as the work of the European Parliament's Committee on Women's Rights and Equal Opportunities. The EU Commission adopted the 8th Annual Report on Equal Opportunities for Women and Men in the European Union (COMDOC (2004) 115, FINAL). "Employment in Europe 2002," the latest statistics, reports information on the state of the implementation process of the Fifth Gender Equality Action Programme of the Commission and provides analyses the progress in gender mainstreaming in a broad range of EU policies.

The SHARE consortium includes both private and public institutions as well as individuals from 9 nations in its project partnership. General rules of gender equality and anti-discrimination, equal pay for equal work, punishment of sexual harassment etc., are already in place and being implemented by means of legal regulations or are otherwise mandatory for all partners. Although there is much in common, certain national, as well as local differences in legislation and in good practice of equal opportunity have to be acknowledged.

As the labor relationships within the project are frequently of a temporary nature for legal reasons, the intention of the Commission to monitor the implementation of the Directive on Parental Leave, as reported in chapter V of the 8th Annual Report on Equal Opportunities for Women and Men in the European Union (2004), cannot be achieved directly.