SERIES
SEISMIC ENGINEERING RESEARCH INFRASTRUCTURES FOR EUROPEAN SYNERGIES

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Deliverable D4.9 – Report of coordination with networks on earthquake engineering and related FP projects

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D4.9 – Coordination with networks on earthquake engineering and related FP projects
ABSTRACT

The scope of this Deliverable is to summarize the interaction of SERIES with international, European and national networks in earthquake engineering, as well as with other FP projects on earthquake engineering or closely related topics. Although in essence these two goals are interconnected, they are treated herein individually to reflect the efforts in two separate tasks of the project, NA3.3 and NA3.4, respectively.

The main objective of co-ordination with international networks for earthquake engineering was the exchange of information and synergies. Coordination at European and national level – including interaction with other FP projects – mainly aimed at reaching out to Europe’s communities of S/T and practice in earthquake engineering, increasing awareness of the RTD capacity at the project’s research infrastructures, publicizing TA opportunities, and disseminating RTD results.
D4.9 – Coordination with networks on earthquake engineering and related FP projects
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Introduction

The deliverable at hand summarizes the coordination with international, European and national networks in earthquake engineering, as well as with other FP projects on earthquake engineering or closely related topics, within SERIES. The opportunities for and outcome of this interaction are presented herein in two parts, to reflect the committed efforts in two separate tasks of the project, NA3.3 (Task Leader: UL) and NA3.4 (Task Leader: CEA), respectively.

The main objective of the co-ordination with international networks for earthquake engineering was the exchange of information and synergies. Coordination at European and national level – including interaction with other FP projects – mainly aimed at reaching out to Europe’s communities of S/T and practice in earthquake engineering, increasing awareness of the RTD capacity at the project’s research infrastructures, publicizing TA opportunities, and disseminating RTD results.

In the following, the first part is dedicated to the collaboration with international, European and national networks for earthquake engineering, whilst the second part focuses on the interaction with other related FP projects.
1 Coordination with international, European and national networks in earthquake engineering

1.1 INTERNATIONAL NETWORKING

1.1.1 World Forum on Collaborative Research in Earthquake Engineering (WFCREE)

JRC organised the 4th International Conference on Advances in Experimental Structural Engineering (4AESE), at the JRC on 29th-30th June 2011. The workshop was a follow up of the World Forum on Collaborative Research in Earthquake Engineering (WFCREE). The overall objective of the conference was to continue the efforts of the International Association for Experimental Structural Engineering (IAESE) to promote international collaboration and dissemination of research findings within IAESE’s core research area. To further this interaction the conference was held concurrently with the 2nd EFAST workshop (30 June, 2011). Besides the organiser, several SERIES beneficiaries (UPAT, CEA, EUCENTRE, GDS, TUIASI, UNITN, UNIKA, UOXF.DF, VCE) participated in this event. All three US-NSF centres in earthquake engineering (PEER, MCEER and MAE), most of the US-NEES facilities (alongside the coordinators of US-NEES, Profs. Roberto Leon and Julio Ramirez), Tongji University, etc., were represented, giving the opportunity for interaction with the SERIES beneficiaries.

1.1.2 Interaction with the three US-NSF centres in earthquake engineering (MCREE, PEER and MAE) and US-NEES

Besides interacting with US-NSF centre members at major earthquake engineering conferences, as described in various subsections of this deliverable, networking with two of the three US-NSF centres in earthquake engineering (Pacific Earthquake Engineering Research Center (PEER) and Mid-America Earthquake Center (MAE)) was planned out throughout the project. For instance, at the Workshop “Performance-based Earthquake Engineering”, organised by UPAT in July 2009 in the context of FP7 CSA project ACES (liaising with SERIES in PEER and MAE, Task NA3.4), researchers from 13 SERIES beneficiaries (including four SERIES TA facilities)
interacted with 10 representatives from US research infrastructures in PEER and MAE. Moreover, MAE Director, Prof. A. Elnashai, was appointed in the Advisory Panel for research infrastructures in earthquake engineering (see Task NA3.5). Regular communication with Julio Ramirez from US-NEES was established for the possibilities of data exchange between SERIES and US-NEES (US Network for Earthquake Engineering Simulation) and a SERIES-NEES protocol for cooperation in this respect was discussed and drafted.

Further interaction was achieved via the collaboration of NA3.3 Task Leader (UL) with PEER for the development of a database of seismic test results in Task NA1.5. Prof. D. Lignos, currently at McGill University and before at Stanford University, and Prof. H. Krawinkler of Stanford the University developed a database of about 200 tests of reinforced concrete beams. This database was kindly provided by the authors to UL in order to be included (after some further processing performed by UL and UPAT) in the SERIES database in Task NA1.5.

A formal cooperation between the SERIES partner UL and the PEER partner Stanford University was established within two bilateral projects. The first one, entitled "Protection of built environment against earthquakes", was carried out in the period 2011-2013. The visits of Prof. P. Fajfar and his colleagues to Stanford University and other PEER partners, especially the University of California, Berkeley, where the PEER headquarters is located, have provided ample opportunities for discussions and exchange of views with PEER partners. A continuation of the bilateral project between UL and Stanford University, entitled "Risk-based seismic design of structures", started in 2013.

UL also organised Workshop Bled4 on "Performance-based seismic engineering: Vision for an earthquake resilient society" in Bled (Slovenia), on June 24-27, 2011 (http://bled4.si). Besides the organiser, SERIES beneficiaries UPAT and UNINA participated, alongside a large number of participants from two US-NSF centres in earthquake engineering (PEER and MCEER (Multidisciplinary Center for Earthquake Engineering Research)), some of the US-NEES facilities, E-DEFENCE (Hyogo Earthquake Engineering Research Center), NCREE (National Center for Research on Earthquake Engineering-Taiwan), and other organizations, giving good opportunity for interaction on technical matters of common interest. The participation at the workshop was by invitation only. Among others, the workshop participants were the former and the present PEER director Prof. J. Moehle and Prof. S. Mahin, both from University of California, Berkeley, the E-DEFENCE director Prof. M. Nakashima from Kyoto University and the NCREE director Prof. K.C.Tsai. European participants were, among others, the SERIES
coordinator Prof. M. Fardis (UPAT) and the SERIES NA3.3 coordinator Prof. P. Fajfar (UL). There are rare opportunities for gathering a group of world leading researchers in a productive atmosphere of a workshop; so, it is expected that the discussions during the workshop and the proceedings which will be published by Springer will influence the future developments in the field of earthquake engineering.

UL organized also the workshop “Protection of the built environment against earthquakes” in Ljubljana on August 27 and 28, 2010 (http://ice4risk.slo-projekt.info/workshop/). Among the invited participants, the great majority were young (below 40 years) but already established researchers which are expected to become the major players in earthquake engineering in near future. Besides the workshop organizers UL, participants came from SERIES partners AUTH, EUCENTRE, NTUA and UNAP. The overseas participants were from two universities participating in the PEER center (Stanford University and University of California, Irvine) and from New Zealand. As usual at small workshops, there were excellent opportunities for in-depth discussions. The proceedings were published in the monograph "Protection of built environment against earthquakes", M. Dolšek (editor), Springer, 2011.

JRC attended the Vision 2020 Workshop – An Open Space Technology, held in St Louis, Missouri, on 25th-26th January 2010. The workshop was sponsored by the National Science Foundation (NSF-USA) to formulate a vision of where Earthquake Engineering in the USA needs to be in 2020. The goals were to derive the emerging principal new directions in earthquake engineering research, practice, education and outreach to be followed by the earthquake engineering community in the next 10 years and to maximize the use of NSF NEES facilities to enable rapid progress along these new directions. The workshop provided a framework for exchanging European and USA views on the advancement of earthquake engineering for the next decade, and will provide input to Task NA3.5, in particular for the drafting of the Strategic Agenda for international collaborative research in earthquake engineering.

In the framework of the 15WCEE (Lisbon), a SERIES-NEES/NSF Meeting was held on 27 September 2012 between:

- SERIES partners UPAT (M.N. Fardis), JRC (A. Pinto, F. Taucer) and UNIVBRIS (C. Taylor) and
- J. Pauschke (US-NSF), J. Ramirez (Director of US-NEES), B. Fossum (Deputy Director of US-NEES) and B. Holmes (US-NEES Governance Board Chair).
The aim of the meeting was to draw a future collaboration plan between US-NEES and SERIES, so as to enhance ties. Key points of discussion were the following:

a) Great interest was expressed to establish procedures and protocols for the sharing of data – in particular in what concerns intellectual property rights –, between the SERIES DDB and the NEESHub central database (NEESCom) and NSF.

b) It was acknowledged that the capacity to perform distributed hybrid simulations is an important topic that needs to be further developed in the future. For distributed testing, the protocols defined by NEES and NCREE are being used and contacts have already been established with NEES laboratory nodes (NA1.4).

c) In general, the likelihood of a successor programme of SERIES and the continuation of NEES for the period 2015-2019 were discussed; it is foreseen that after 2019, NEES should integrate the whole Earthquake Engineering Community at global scale; thus the interest of NEES in establishing a possible collaboration with its European counterparts. Besides, NSF funds people to move and work in non-US laboratories. In the future, NEES will give a large importance on networking.

d) The joint organisation of the SERIES Concluding Workshop was discussed, in order to highlight the importance of international collaboration and the necessity to secure more financing in Europe in this respect.

Collaboration with the US-NEES/NSF is very important for SERIES, as the existing know-how in the US would bring great benefit to European researchers. It was commonly expressed that this joint Workshop ought to be an opportunity to define the future of Earthquake Engineering in Europe and how a vision for collaboration with the US can be put forward.

The joint organization of the SERIES Concluding Workshop “Earthquake Engineering Research Infrastructures” in Ispra (Italy) on May 28-30, 2013 (dedicated to the memory of Prof. Roy Severn) was a milestone in the collaboration between SERIES and US-NEES members. The Workshop included a special session on Hybrid simulation and presented the main outcomes of the SERIES project and of parallel developments within NEES. US-NEES participants (11 in total, including the network coordinator Julio Ramirez) contributed 9 presentations out of a total of 52 presentations. The possibility to enhance collaboration through data exchange in the course of a potential SERIES successor program was discussed. Overall, communication with Julio Ramirez was regular throughout the project. The Concluding Workshop gave the opportunity to
all SERIES partners to get acquainted with US-NEES members and developments and to discuss in person future collaboration possibilities.

Conclusions of the Workshop and recommendations were discussed at the closure of the Workshop with the participation of the coordinator Michael Fardis, Julio Ramirez from US-NEES, the External Scientific Committee and contributions from the floor. The significant conclusions concerning SERIES and US-NEES are listed below:

- There are several opportunities for a possible NEES-SERIES Collaboration, notably concerning:
  i. Interoperability of Databases (Shared Ontology, Case Studies)
  ii. Sharing facilities' best practices, especially in training and certification protocols
  iii. Hybrid Simulation
  iv. Dissemination
  v. Access to facilities
  vi. Service to industry

- A possible NEES-SERIES Collaboration faces certain challenges, especially concerning:
  i. Funding
  ii. Coordination of the activities
  iii. Identification of partners contributing to the collaboration
  iv. Standards for Interoperability
  v. Dissemination of global success stories

- More specifically, concerning possible collaboration between NEES and SERIES in hybrid testing, challenges and opportunities include:
  i. Ensuring that tools can be used broadly and not re-invented
  ii. Standards for communication so that tools can work together
  iii. Common metrics for evaluating performance, benchmark problems
  iv. Better delineation and communication of the needs for this technology by the hybrid testing community.
  v. Demonstrating what can be achieved with hybrid simulation, especially when traditional methods cannot be used

- A possible framework for the NEES-SERIES Collaboration in hybrid testing may include:
  i. Trans-Atlantic collaborations through demonstration projects or benchmark problems, to illustrate the power of hybrid simulation; Workshops to make specific plans for moving forward
  ii. Participation of EU researchers in the Quake Summit, August 6-8, 2013 for the Hybrid simulation working meeting and the annual NEES meeting
  iii. Student exchanges
iv. Training of students in the use of open-source tools and methods
v. A short course or other activity to increase awareness and enable new users

- SERIES cannot be compared to US-NEES in terms of human resources involved, funding, testing and IT capabilities, etc. Besides, SERIES had a 4.5-year duration, while US-NEES has been running continuously since 2000 and is presently planned to continue seamlessly to the end of the 2020 decade.

- SERIES operated in a diverse political and cultural environment; one of its main goals was to bring together the entire S/T seismic engineering community of that diverse environment, a major achievement by itself; this not an issue in US-NEES.

In SERIES all players in the European S/T seismic engineering community had to work together, without competing against each other; there were only winners. US-NEES works differently in this respect.

1.1.3 Interaction with earthquake engineering centres in East Asia: Tongji University in Shanghai, KOCED PMC and SNU in S. Korea, and National Center for Research on Earthquake Engineering of Taiwan (NCREE)

Regular exchanges with the emerging earthquake engineering centre in Tongji University (Shanghai) took place throughout the project. Prof. M.N. Fardis was invited there in October 2009, visited their lab facilities and delivered the opening lecture to the 2nd Kwang-Hua World Forum on Performance-based Design Theory and Code Development for Civil and Structural Engineering. Profs. Bin Zhao and Wensheng Lu of Tongji University visited the ELSA facility. JRC signed a Memorandum of Understanding on January 2010 with Tongji University to establish a mutually beneficial cooperation in the field of seismic vulnerability and protection of civil engineering structures, and is in the process of renewing a Collaborative Research Arrangement starting in 2013 for the duration of five years. Two visits were undertaken by JRC to Tongji, the first by M. Geradin on July 2009, and the second one by A. Pinto on June 2010, to present the activities of ELSA and to exchange ideas on the construction of the new experimental facilities at Tongji. Several papers have been co-authored with a researcher from Tongji that undertook his post-doc at ELSA on the Wenchuan earthquake and on the seismic design of RC and masonry building structures according to Chinese Standards and Eurocode 8.

Prof. M.N. Fardis was also invited to present the SERIES project to 4th Kwang-Hua Forum and Opening Symposium of Tongji Shaking Table Array, on Dec. 10-12, 2011 in Shanghai.
(http://risedr.tongji.edu.cn/4th_KwangHua_Forum/downfile/PS_1/Michael_N_Fardis.pdf.) Other SERIES beneficiaries participating were CEA, EUCENTRE, JRC, UNIKA and UNITN. All three US-NSF centres in earthquake engineering (PEER, MCEER and MAE), many US-NEES facilities and NCREE were represented. Note that the new Earthquake Engineering laboratory at Tongji is an impressive physical infrastructure, with currently no parallel in Europe, and of similar calibre to the best such infrastructures in the US, Japan or Taiwan. More recently, F. Taucer (JRC) was invited to the Fifth Kwang-Hua Forum on Innovations and Implementations in Earthquake Engineering Research, where he gave a presentation titled “SERIES: A platform of cooperation between European research infrastructures in earthquake engineering”; another SERIES partner in the forum was CEA. There were also other international networks on earthquake engineering, namely US-NEES and NCREE.

Prof. Bin Zhao of Tongji University attended by invitation the SERIES concluding workshop in Ispra on May 28-30, 2013, and contributed with a paper.

JRC supported the "International Workshop on Infrastructure Systems for Nuclear Energy" (IWISNE), held on 5-17 December 2010 in Taipei, Taiwan. The workshop was organized by NCREE and had as one of its main objectives to provide a forum for world-leading experts to meet and search for the best ways to design safe infrastructure systems for nuclear energy activities.

Various international activities were performed in the framework of NA1.4, not initially envisaged in the DoW, without requiring any additional person-power: a series of international contacts and visits were pursued with other facilities and earthquake engineering networks outside Europe. This turned out to be a necessary key component for the success of the European Platform for Distributed Testing, since it allowed: testing the platform with partners outside Europe; direct contact with the institutions that have developed the protocol; gathering experience in distributed testing more efficiently. To this end, visits to key facilities were conducted in order to both establish international contacts and to contribute to the European efforts to create a platform for distributed tests. Researchers from UNIKA visited NCREE (responsible for PNSE, Taiwan), E-Defense (Japan) and Osaka Institute of Technology in March 2010. They also visited NEES-US research infrastructures: Lehigh University (ATLSS), State University of NY at Buffalo (SEESL), University of Illinois at Urbana-Champaign (UIUC) and University of California at Berkeley (PEER) (responsible for OpenFresco) in November 2010. Finally, they made visits to two facilities of the emergent earthquake engineering network
KOCED in South Korea in September 2011: the Hybrid Structural Testing Center (HYSTEC) and the Seismic Simulation Test Center (SESTEC). As a result of these activities, serious advancements and cooperation has been established with the facilities of PEER from the NEES side, NCREE in Taiwan and HYSTEC in South Korea. Noteworthy output can be summarized as follows:

- UNIKA adapted Dorka’s substructure algorithm in order to work with the different protocols available. The use of this algorithm was a key component in the success of performing, for the first time, continuous distributed tests in the transcontinental scale.
- UNIKA presented two papers related to the work within SERIES NA1.4 at the ICEAS'11 International Conference in Seoul, South Korea, in 2011.
- UNIKA presented one paper at the 15th World Conference on Earthquake Engineering in Lisbon in 2012.
- UNIKA was invited at the 5th Kwang Hua Forum in December 2012 to present the recent advancements on continuous distributed testing that were done during SERIES.
- UNIKA and PEER collaborated in the development of a new experimental control facility for OpenFresco in order to have a hardware and software independent module in OpenFresco.
- Distributed tests were performed by UNIKA and HYSTEC using OpenFresco and OpenSees. First numerically, afterward with a linear specimen (in HYSTEC) and then with a non-linear specimen (in HYSTEC).
- Collaboration between UNIKA and the University of California at Berkeley resulted, for the first time, in the performance of transcontinental continuous (time-scaled) distributed tests with a non-linear specimen and the newly created module for OpenFresco. Dorka’s substructure algorithm was the backbone of this set-up and a key component in its success.
- UNIKA adapted the substructure algorithm to work with the second version of the NSEP protocol and together with NCREE performed transcontinental \textit{continuous} (time-scaled) tests with a non-linear specimen.

To sum up, contact with international facilities helped: inform partners in international networks on the creation of a European Platform for Distributed Testing; gather practical experience in distributed testing; adapt algorithms and software to connect beneficiaries; evaluate the
performance of the platform; evaluate the different protocols (OpenFresco and NSEP); and perform continuous time-scaled tests with a non-linear specimen.

1.1.4 International Association for Earthquake Engineering (IAEE)

Liaison with IAEE was highlighted through the 15th World Conference on Earthquake Engineering (15WCEE), in Lisbon, organized by the Portuguese Association for Earthquake Engineering (SPES) under the auspices of the IAEE. The SERIES beneficiary LNEC participated in the organization of the conference (Ema Coelho of LNEC is Vice-President of SPES and was a member of the Organizing Committee; Alfredo Campos Costa of LNEC was a member of the Local Advisory and of the Scientific Committees) and provided the resources for holding SERIES coordination meetings on different work packages of the project during the 15WCEE. The conference was an important dissemination channel for the spread of RTD results and for the promotion of RTD and TA capabilities within a key sample of the international community of S/T and practice in earthquake engineering.

Moreover, LNEC hosted the “Preparatory Course on Dynamic Experimental Testing”, one of the SERIES training courses during the 15WCEE in September 2012, ensuring a special interaction with the 15WCEE "Blind Test Challenge" also hosted by LNEC and involving seismic tests on LNEC shake table. Alfredo Campos Costa chaired the organization of the "Challenge".

1.2 EUROPEAN NETWORKING

1.2.1 European Association of Earthquake Engineering (EAEE)

Liaison with EAEE was one of the main publicity channels for the RTD capabilities and TA opportunities at the project’s research infrastructures and for spreading RTD results to the European communities of S/T and practice in earthquake engineering. Networking with EAEE has been extensive during the project, mainly through WP4 Leader KOERI and notably Prof. A. Ansal, who serves as EAEE’s Secretary General. Liaison was effected via the EAEE’s Newsletter and web site, its Scientific Journal (Bulletin of Earthquake Engineering) and the 14th European Conference on Earthquake Engineering (ECEE) organised by IZIIS in 2010. The 2nd
SERIES Workshop took place in Ohrid on the penultimate day of the 14ECEE, organised by EAEE, and was included in its programme, giving the opportunity to 14ECEE participants to follow the SERIES Workshop.

EAEE also supported the publication of the books related to the SERIES Workshops in the Springer book series on Geological, Geotechnical and Earthquake Engineering, with the EAEE Secretary General as the Editor in Chief.

EAEE also played an important role as a sister organisation of the European Seismological Commission (ESC) in introducing some of the activities within SERIES to the seismology community during the 2010 Montpellier and 2012 Moscow ESC General Assemblies.

1.2.2 CEN/TC250/SC8

Liaison with CEN/TC250/SC8 – the CEN Subcommittee responsible for drafting and maintaining the European Standard for seismic design EN-Eurocode 8: Design of structures for earthquake resistance – was achieved mainly through its permanent Secretariat, held by SERIES beneficiary LNEC (Dr Ema Coelho and Dr Luisa Sousa), and its current Chairman (Dr Eduardo Carvalho), who serves on the SERIES External Scientific Committee and the SERIES Advisory Panel of Research Infrastructures in earthquake engineering. In addition, researchers from SERIES partners serve as national representatives in the CEN Subcommittee (Prof. A. Pecker, France (GDS), Prof. P.Fajfar, Slovenia (UL)). The project Coordinator was former Chairman of CEN/TC250/SC8.

The JRC provides Support to DG Enterprise for the implementation, harmonization and further development of the Eurocodes, with three main objectives: to achieve full implementation of the Eurocodes, further harmonization and evolution of the Eurocodes and promotion of the Eurocodes outside Europe.

The Eurocode 8 will soon become the exclusive seismic design standard throughout the European Community and this solid interaction had the advantages, on one hand, of allowing the work developed within the project SERIES to give a contribution to the Eurocode 8 community, and, on the other hand, of bringing to the SERIES environment the main developments and the on-going evolution of seismic design codes in Europe.
1.2.3 European Construction Technology Platform (ECTP)

The European Construction Technology Platform (ECTP) represents the European Construction industry covering 10% of GNP. Almost half of the effort goes into renovation and mitigation of existing structures and buildings. With the enhanced hazard assessment supported by Eurocode 8 (EN 1998) the European construction industry sees a vital point of interest in collaboration with earthquake engineers. The subject of earthquake mitigation has been on the agenda throughout FP7. Among the many items to be covered, the following became priorities:

- Assessment of masonry buildings to define the capacities against strong ground motion
- Methods for seismic upgrade of structures
- Methodologies to protect strategically important buildings in Europe and to ensure their function in case of an earthquake
- Further improvement and enlargement of Eurocode 8.

For some of the activities a strong European testing infrastructure is necessary. Seismic qualification and certification are also a point of interest for future development work.

Liaison with ECTP, the European Construction Sector’s body that developed its Strategic Research Agenda to provide input for the EC’s Framework Programs, was provided by beneficiary UL. Through the meetings at the level of Executive Board the ideas launched within SERIES Project were promoted and become familiar to all interested stakeholders. This is especially important in the time of preparation research within Horizon 2020 where the issue of mitigation of natural disasters should be well addressed. Also, the outcome of SERIES will contribute to the general mission of ECTP, which is raising the sector to a higher world level of performance and competitiveness. Research and innovation strategies which have been developed to meet these challenges are expected to mobilize the wide range of leading skills, expertise and talent available to industry over the coming decades, in order to meet the needs of the society. Prof. R. Zarnic (UL) contributed to development of strategic documents of ECTP and co-coordinated the Focus Area Cultural Heritage (FACH) since its launching in 2004. The Strategic Agenda of FACH has been one of background documents which served EC for launching of FP7 calls related to cultural heritage preventive conservation and safeguarding. Three successfully concluded projects contributed to improving the earthquake safety of masonry heritage buildings and monuments.
The JRC has actively participated to ECTP initiatives reFINE and E2B, providing input and feedback for drafting the RoadMap and Vision for “Building Up Infrastructure Networks of a Sustainable Europe” and “Towards the creation of a high-tech building industry: Turning energy efficiency into sustainable business”, raising the importance of experimental research in earthquake engineering in reaching the goals of safer and sustainable infrastructure in Europe.

1.2.4 International Federation for Structural Concrete (Fédération Internationale du Béton, fib)

fib is the Euro-centred international organisation of researchers, academia, practitioners and industry for the S/T advancement of Structural Concrete. It organises high level Symposia and Congresses and produces technical reports, model codes, etc. (its 1985 Seismic Model Code was the basis for Eurocode 8; it has recently completed the 2010 Model Code that includes seismic design). Networking with fib was extensive, via SERIES beneficiaries ITU and UPAT.

It is noteworthy that fib Model Code 2010 (replacing the CEB/FIP Model Code 1990) includes, for the first time, sections on seismic design, to which SERIES partner UPAT had significant input. Moreover, UPAT organised the 2nd Workshop of ACES (an FP7 project liaising with SERIES, see below) in conjunction with a meeting of the Technical Council of fib. SERIES beneficiary ITU, who represents Turkey in fib, participated in both events, alongside two members of the SERIES External Scientific Committee.

1.2.5 European Earthquake Protection Initiative (EEPI)

The European Earthquake Protection Initiative (EEPI) was launched in 2007 to promote enhancement of seismic protection in the EU via RTD. EEPI has been initiated at a time when earthquake issues disappeared from the calls in the coming Framework Programs. The main target has been to produce a Strategic Research Agenda for earthquake engineering which has been done. After that earthquakes returned back to the agenda and new projects appeared. Therefore the initiative has been obsolete as the agenda was taken over by existing projects like NERA (262330 CP-CSA-Infra).

Liaison with EEPI was mainly ensured via SERIES beneficiary VCE, which is also the driving force of EEPI, with the contribution of JRC and AUTH.

Another edition of the Strategic Research Agenda and Roadmap is currently under
preparation. Agreement with the seismologist community has been made to offer a joint document now named Strategic Research Agenda on Earthquake Risk. Considerable progress has been made in this direction.

1.2.6 European Reference Network for Critical Infrastructure Protection (ERNCIP)

Collaboration with a new network, the "European Reference Network for Critical Infrastructure Protection" (ERNCIP) started near the end of the 2nd period. ERNCIP (http://ipsc.jrc.ec.europa.eu/index.php/ERNCIP/688/0/) was set up in 2009 by the JRC, under the mandate of DG Home in the context of the European Programme for Critical Infrastructure Protection (EPCIP). It aims at providing a framework within which experimental installations can share knowledge and expertise in order to harmonise test protocols throughout Europe leading to better protection of Critical Infrastructures against all hazards. Further aims are to improve the conditions for EU-wide certification and standardization of security solutions. So, the mission of ERNCIP is to foster the emergence of innovative, qualified, efficient and competitive security solutions, via networking of European experimental capabilities.

The SERIES project interacted with ERNCIP by registering its seven facilities offering TA access to the database of ERNCIP, as well as other SERIES beneficiaries with experimental installations which may be interested in joining the database. SERIES may join the Thematic Area “Structural Resistance against Seismic Risks”, with Fabio Taucer (JRC) as contact point with SERIES. The objectives of the Thematic Group meet those of the NA activities of SERIES; as such, SERIES will keep ERNCIP informed about developments in these activities.

1.3 NETWORKING AT NATIONAL LEVEL

1.3.1 ReLUIS

The Network of University Laboratories in Earthquake Engineering (in Italian, Rete dei Laboratori Universitari di Ingegneria Sismica, ie. ReLUIS) is a consortium comprising a number of leading Italian universities, located in strategic positions throughout the Italian Peninsula. The consortium was established in 2003 and is aimed at managing all the research work carried out in the laboratories of the affiliated universities. In so doing, it provides technical, managerial and
financial support to the university centers of ReLUIS and promotes the advances and innovative materials and technologies in the field of earthquake engineering. Its target is to provide a robust and dynamic platform for the exchange of the know-how and technical background between universities and research centres, on one hand, and governmental institutions, public and private research establishments and stakeholders, on the other hand, to minimize the seismic risk of the built environment.

The consortium is headquartered at the University of Naples, Federico II, Department of Structures for Engineering and Architecture (Di.St.). Its structure includes a board of directors and a chairman; the present chair is professor Gaetano Manfredi, vice-Provost of UNAP; past chairs were professor Edoardo Cosenza, past Dean of the Faculty of Engineering of the University of Naples, Federico II and professor Mauro Dolce, Director of the Department of Civil Protection, Seismic Risk. The founding and partner Italian universities of the ReLUIS consortium are as follows (Figure 1.3.1.1):

- University of Basilicata at Potenza, Department of Structures, Geotechnics and Geology applied to the Engineering;
- University of Naples, Federico II, Department of Structural Engineering (UNAP);
- University of Pavia, Department of Civil Engineering and Architecture (EUCENTRE);
- University of Trento, Department of Structural Mechanics (UNITN).

Therefore, of the four ReLUIS partners, three (UNAP, EUCENTRE, UNITN) are SERIES partners.

A formal agreement for collaborative research was also signed with the research centre ENEA UTS Materials and New Technologies, based at Casaccia, Rome.

The partner universities and ENEA possess large experimental facilities, as also shown pictorially in Figure 1.3.1.1, to perform full-scale static, pseudo-static, dynamic and earthquake response analyses. The ReLUIS consortium tends to optimize the features of such facilities, which possess different and complementary technical properties.
The ReLUIS consortium is also extremely active in continuing education, outreach and provides a sound and interactive support to researchers, students, designers and practitioners in the interdisciplinary field of earthquake engineering. Databases of experimental and numerical tests, advanced software and technical papers are shared freely on the official website of the consortium (www.reluis.it). Additionally, handbooks for seismic analysis and design, guidelines and recommendations are also published periodically with the financial support of the consortium.

The members of the consortium are high-profile earthquake engineering researchers that participate to challenging national and international advanced projects, to seismic risk analysis and mitigation, to code drafting and to post-earthquake emergency management, as per example in the recent 6th April 2009 L’Aquila (Italy) and 2012 Emilia earthquakes.

The ReLUIS consortium applies for fund raising both locally and nationwide. It was awarded in 2005 by the Italian Department of Civil Protection for a three-year 15million euros (5 million euros per annum) project research, which ended in 2009. It was proposed than more than 50% of the total budget was allocated to perform experimental tests on components, sub-assemblages and structures subjected to either static or dynamic monotonic and/or cyclic loading. The project has involved 40 universities and research centers nationwide, with 127 research groups (research unit) and more than 800 researchers. The majority of the researchers
were PhD students and young research assistants. A panel of international experts reviewed technical reports, including Professor M.N. Fardis (UPAT), Professor R. Leon (GeorgiaTech, USA), Dr. A. Pecker (GDS, France), Professor R. Spence (University of Cambridge, UK) and Professor M. Tomazevic (National Building and Civil Engineering Institute, Slovenia). The SERIES Mid-term review meeting in Napoli was partly supported by ReLUIS.

The project is continued in the period 2010-2013 (www.reluis.it), again with essentially all Italian University teams active in earthquake engineering and more research centers. Prof. A.S. Elnashai (University of Illinois, USA), Prof. P.Fajfar (UL) and Prof. K.Pitilakis (AUTH) serve in the group of three international reviewers of the project.

1.3.2 UK Network for Earthquake Engineering Simulation (UK-NEES)

UK-NEES is a collaborative grid-based research network featuring the UK's three leading earthquake engineering laboratories, namely UNIVBRIS (coordinating beneficiary), UOXF.DF and UCAM (all three SERIES beneficiaries). UK-NEES enables participation by remote researchers in experiments through on-line data streaming (teleobservation), two-way audio-video links (teleparticipation), remote operation of certain facilities (teleoperation), synchronous operation of geographically distributed experimental facilities in a common experiment (distributed hybrid testing), and the archiving and sharing of data via a curated data repository. The UK-NEES network has helped to: (i) optimise the utility of the affiliated research infrastructures by opening them up to users around the UK and the wider world; (ii) enhance collaboration and integration of research effort; (iii) enable testing of larger and more complex structures than can be tested in a single lab; and (iv) reduce the need to replicate expensive facilities in numerous locations. This project included a series of tests that evaluated the capabilities for tele-participation and distributed testing. Tele-participation tests took place within the UK, across Europe, and with both trans-Atlantic and trans-Pacific partners. A series of distributed hybrid tests were conducted to demonstrate and evaluate the UK-NEES system architecture. In the UK first, a stable three-site distributed hybrid test was completed wherein three geographically-dispersed physical models undergoing seismic motion were coupled via a numerical model.

The affiliation of each UK-NEES member within the SERIES consortium has produced significant levels of networking and cross pollination between the two projects. As such, UK-
NEES members have actively participated in all SERIES workshops and many SERIES meetings. In addition, the three main components of the platform developed under UK-NEES (data repository, teleparticipation facilities and distributed testing capabilities) has informed the development of the European platform for earthquake engineering instigated under the SERIES project:

- The SERIES data repository (Task NA1.1, database specification, and Task NA1.3, database implementation), that is used to store experimental results, and the associated tools to interact with the data and to share information between the project members, draws heavily from, improves upon and supersedes the UK-NEES data repository.
- The teleparticipation facilities implemented under UK-NEES consist of a common telepresence hardware and software infrastructure implemented by each project member. The infrastructure makes extensive use of the tools and technologies developed by US NEES. Practical guidance and support for the implementation of these tools was provided by UK-NEES to all interested members of the SERIES consortium (Task NA1.2, telepresence implementation).
- The distributed tests conducted between the UK-NEES members provided the basis for the development of a testing-support platform for distributed testing called Celestina that has been developed under SERIES (Task NA1.4, distributed testing). The development of Celestina was supported by the expertise gathered from the UK-NEES distributed tests. The software has proved able to conduct robust and reliable distributed testing, allowing real-time operation and the integration of heterogeneous testing systems. It appears to be the only program that assists with the use of different network protocols other than TCP.

2 Interaction with other FP projects

2.1 E-FAST – Design study of a European facility for advanced seismic testing

The aim of FP7 Research Infrastructures project (2008-11) “Design study of a European facility
for advanced seismic testing” (E-FAST) was to define the future European seismic testing facility. Several issues, addressed later in SERIES have been studied in a first step in E-FAST. In particular:

- a comprehensive synthesis of the state of the art on real time substructure testing was carried out;
- real time substructure tests were done in UNIKA, EUCENTRE and CEA;
- advanced measurement techniques (non-contact measures, accurate load cells) were used and developed;
- a reflection on experimental protocols started;
- issues related to communication modes and data transfer between computers for geographically tests were studied;
- a telepresence room was designed;
- a synthesis on the state of the art of hydraulic systems used for earthquake tests was done.

SERIES used the achievements of E-FAST, in order to advance further the state-of-the-art.

Networking and liaison with E-FAST was continuous and intense, accomplished by all of its five partners (CEA, EUCENTE, JRC, TUIasi, UNIKA) which are also SERIES beneficiaries. Seven additional SERIES beneficiaries (with 10 researchers) participated in E-FAST’s 1st Workshop on 2-3 March, 2009 at the JRC. E-FAST was invited to present its main outcomes at the 2nd International Workshop of SERIES, in Ohrid (MK), on September 2nd, 2010. That presentation was indeed one of the highlights of the SERIES Workshop and was included in the Proceedings of the Workshop, published by Springer. SERIES beneficiaries also participated in E-FAST’s 2nd Workshop. The 2nd Workshop was organized by JRC on June 25th-30th, 2011, in conjunction with the 4th International Conference on Advances in Experimental Structural Engineering (4AESE), giving opportunity to five beneficiaries of SERIES but not of E-FAST to attend.

Furthermore, UNIKA organized an EFAST-SERIES Workshop in Kassel on October 21-22, 2010 on Substructure and Distributed Testing. Presentations of the Workshop are available at the SERIES web portal. Contributions to the Workshop were made by beneficiaries UNITN, JRC, UOXF and UNIKA. Each affiliation contributed a presentation on substructure testing, sharing the respective experience and progress made in this field. UOXF and UNIKA researchers also presented the progress achieved in distributed testing (T. Blakeborough (UOXF) presented the UK-NEES experience and F. Obon Santacana and U. Dorka described the use of large numerical
models and high performance computers in geographically distributed testing). On the occasion, a demonstration of real time substructure testing using the UNIKA shaking table took place. This joint E-FAST/SERIES Workshop was concluded with a round table discussion on the future of substructure and distributed testing and the hardware requirements. The possibilities of the European Platform for Distributed Tests (Task NA1.4) were also discussed.

2.2 SAMCO – Structural assessment monitoring and control

The SAMCO project (Structural Assessment Monitoring and Control) (http://www.samco.org/) has been a very successful basis for further projects in the NMP Program of the European Commission. The agenda and database have been taken over by the large collaborative project IRIS (CP-IP 213968-2) which has entered another dimension in this domain. The results of this follow-up project are published in the IRIS book to be released in August 2013. The project has been ranked as one of the major success stories of FP7.


Considerable reference has been made to SAMCO results and the SAMCO database is still used by researchers worldwide to produce proof of methodologies in the ambient vibration monitoring domain. Interaction with SAMCO was accomplished by its then co-ordinator and SERIES beneficiary, VCE.

2.3 CYBER – Capacity building in earthquake research for risk reduction in urban environments

The aim of FP6 SSA project (2005-08) “Capacity building in earthquake research for risk reduction in urban environments” (CyBER) was to support the infrastructures of METU and its development into a facility of excellence in earthquake engineering. CyBER ended in 2009. Till then and in its follow-up, CyBER’s sole contractor and SERIES beneficiary, METU, ensured interaction with SERIES. Exchange of advanced know-how and technology transfer on seismic testing was achieved through a secondment at the ELSA/JRC centre in CyBER. Collaboration of
CyBER networking partners continued through SERIES.

2.4 LESSLOSS – Risk mitigation for earthquakes and landslides

FP6 Integrated Project “Risk Mitigation for Earthquakes and Landslides” LESSLOSS (2004-07) was coordinated by EUCENTRE and included a 46 partners. Interaction with the follow-up of LESSLOSS (http://www.lessloss.org/main/index.php) was accomplished by its then coordinator and SERIES beneficiary, EUCENTRE, as well as other beneficiaries: AUTH, CEA, ITU, JRC, KOERI, LNEC, METU, NTUA, UNIVBRIS, UCAM, UNAP, UPAT, UL and VCE.

Among the main outcomes of the LESSLOSS Project, several reports (still available on line) focused on seismic design, assessment of existing structures (also at large scale) and vulnerability reduction. The outcomes of LESSLOSS Project were absorbed and taken into consideration within the framework of the SERIES Project, particularly while selecting TA-User Projects and performing TA activities. The LESSLOSS results clearly showed the importance of executing experimental work in order to complement the knowledge and to create available data that scientists and researchers could use to improve seismic protection strategies for both new and existing structures.

2.5 ACES – Advanced centre of excellence in structural and earthquake engineering

“Advanced centre of excellence in structural and earthquake engineering” (ACES) was an FP7-REGPOT Support Action (2008-11) project, aiming at the enhancement of material and human resources of the University of Patras (GR). Networking and liaison with ACES (www.aces.upatras.gr) was achieved through ACES’s sole beneficiary, UPAT.

Apart from UPAT, representatives from 12 SERIES beneficiaries (namely EUCENTRE, GDS, METU, NTUA, AUTH, KOERI, UNAP, JRC, CEA, UNITN, UL, UNIVBRIS) participated in the presentations and discussions of the 1st ACES Workshop on “Performance-based Earthquake Engineering” in Corfu (GR) in July 4-7, 2009. ACES also organised a 2nd Workshop on “Innovative Materials and Techniques in Concrete Construction” in Corfu (GR) on October 10-12, 2010, attracting, apart from UPAT, participants from SERIES beneficiary ITU.

Apart from the enhancement of human and material resources, ACES established partnerships between UPAT and 7 networking RTD centres of excellence. Exchange of
advanced know-how and experience on seismic engineering was achieved through short secondments mainly at the ELSA/JRC centre and secondarily at the TAMARIS lab at CEA (i.e. both SERIES beneficiaries). Collaboration with these networking partners of ACES continued through SERIES.

2.6 NERIES – Network of research infrastructures for European seismology

The aim of “Network of Research Infrastructures for European Seismology” (NERIES): FP6 I3 project (2006-10) was to join the European seismic networks by improving access to data, allowing access to specific seismic infrastructures, etc. Networking and liaison with NERIES (http://www.neries-eu.org/) was accomplished through one beneficiary of both projects, KOERI.

NERIES ended in 2010; its follow-up in the direction of developing a Seismic Hazard Model and Map for Europe is FP7 project SHARE, “Seismic Hazard Harmonization in Europe” (see below, Section 2.12).

2.7 SYNER-G – Systemic seismic vulnerability and risk analysis for buildings, lifeline networks and infrastructures safety gain

SYNER-G is a European collaborative research project focusing on systemic seismic vulnerability and risk analysis of buildings, transportation and utility networks and critical facilities. The originality of the project is the systemic approach of vulnerability and risk assessment of complex interacting systems. The whole methodology is implemented in an open source software tool and is validated in selected case studies. Interaction has been established with SYNER-G the coordinator of which is also a SERIES beneficiary (AUTH, Prof. Pitilakis). Four more participants of SYNER-G (www.syner-g.eu) are also beneficiaries of SERIES (JRC, METU, UPAT, VCE). Among other topics of SYNER-G, the following present a common interest with SERIES: the detailed taxonomy of the built environment into its component systems (buildings, transportation and utility networks, critical facilities) and the fragility relationships for vulnerability analysis of elements at risk.

There was an open invitation to the beneficiaries of SYNER-G to participate at the International Workshop of SERIES in Istanbul; besides, to enhance interaction, the coordinator of SYNER-G, Prof. K.Pitilakis, was a member of the Scientific Committee of that Workshop.
Lastly, drafting of the Strategic Agenda for international collaborative research in Earthquake Engineering (SERIES Deliverable D4.6 or D4.11 following the numbering in the amended DoW) was carried out with the contribution of K. Pitilakis, coordinator of SYNER-G, as part of the Dissemination Activities of the latter project.

2.8 **NERA – Network of European research infrastructures for earthquake risk assessment and mitigation**

Interaction was also established with FP7 project NERA “Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation” (www.nera-eu.org) (Infrastructures Integrating Activities), which started after SERIES. NERA (2010-2014) is an EC infrastructure project that integrates key research infrastructures in Europe for monitoring earthquakes and assessing their hazard and risk. NERA integrates and facilitates the use of these infrastructures and access to data for research, provides services and access to earthquake data and parameters, and hazard and risk products and tools. The NERA consortium consists of 28 participants (European universities and research centres), five of which are joint beneficiaries with SERIES (AUTH, EUCENTRE, KOERI, METU, VCE). The SERIES coordinator M.N. Fardis is a member of the 5-strong Advisory Board of the project.

Interaction is established especially through the networking activities (NA) of NERA, some of which include access to European seismic waveform data (NA2), a living database infrastructure of strong motion data (NA3), and establishment of a network of field testing infrastructures with standardized approaches (NA6). Products from the various NERA activities will be integrated into the Earthquake Data Portal, originally developed by the NERIES EC project, by augmenting the existing stable and operational Portal with new data access tools and data sets from the new NERA partners and by extending and standardizing the web data services layer within a common services architecture (NA9).

2.9 **SAFECAST – Performance of innovative mechanical connections in precast building structures under seismic conditions**

Another FP7 project that started at approximately the same time as SERIES and with which interaction was established is SAFECAST “Performance of Innovative Mechanical Connections
in Precast Building Structures under Seismic Conditions”. Five SERIES beneficiaries participate in this project (ITU, JRC, LNEC, NTUA, UL) in addition to several industrial companies involved in production of reinforced concrete precast industrial buildings. The SERIES coordinator, Prof. M.N. Fardis, was invited to chair the Concluding Workshop of SAFECAST in March 2012.

2.10 SAFECLADDING – Improved fastening systems of cladding wall panels of precast buildings in seismic zones

This FP7 project represents a follow-up project of the SAFECAST project. A very similar group of partners as in the case of the SAFECAST project is involved in the SAFECLADDING project in the period 2012-2015. Four SERIES beneficiaries (ITU, JRC, NTUA, UL) participate in this project.

2.11 IRIS – Integrated European industrial risk reduction system

Current practices in risk assessment and management for industrial systems are characterized by methodical diversity and fragmented approaches. In retrospect, these risk and safety paradigms resulted from diverse industries driven and limited by available knowledge and technologies. A change based on industry-driven R&D work is needed.

At present, the European Industry has recognised the obligation to reconsider risk and safety policies, to have a more competitive industry and a more risk-informed and innovation accepting society in vision.

Therefore the large collaborative project IRIS (37 partners, three of them, CEA, JRC and VCE are also involved in SERIES ) was proposed in order to identify, quantify and mitigate existing and emerging risks, and to create societal benefits, to increase industrial safety and to reduce the impact on human health and the environment.

The IRIS project was led and driven by industry to consolidate and generate knowledge and technologies which enable the integration of new safety concepts related to technical, human, organizational and cultural aspects. The partnership represented over 1 million workers. The project integrated all aspects of industrial safety with priority on saving human lives over cost reductions and in underpinning relevant EU policies.

FP7 projects SERIES and IRIS interacted through the TA experiments performed at the
CEA/EMSI. In particular, the ENISTAT project, which is a key R&D activity enabling to strengthen the current European construction practices with respect to the seismic levels now applicable for European countries following the Eurocode 8 rules. Besides, within the framework of IRIS the JRC performed unique full-scale tests on five reinforced concrete shear wall specimens with loads up to 12 MN, to assess the seismic capacity of the existing civil infrastructure of nuclear power plants.

2.12 SHARE – Seismic hazard harmonization in Europe

Interaction was also established with FP7 project SHARE “Seismic Hazard Harmonization in Europe” (www.share-eu.org), which started in June 2009 and ended in 2012, several institutions having been joint beneficiaries of SHARE and SERIES (AUTH, EUCENTRE/University of Pavia, KOERI, METU, and LNEC). SHARE generated a set of harmonized seismic hazard results and maps, characterizing the hazard and its uncertainty, to serve as input for risk assessment and earthquake resistant design for different applications. Through the coordination at the European Union level, these hazard results will help to harmonize the next generation of national seismic hazard assessments and harmonize the implementation of the European seismic building code (Eurocode 8). A worldwide strong-motion database was also compiled, by combining already existing databases. Online access to the SHARE products is provided through the web portal of the European Facility for Earthquake Hazard and Risk (www.efehr.org) and access will be maintained in the future.

A special interaction was formed within work package WP2 – Engineering Applications, which had the role, among others, of ensuring the consistency and compatibility with the Eurocode 8 requirements, through the liaison with CEN/TC250/SC8, the CEN committee responsible for the Eurocode 8 design. Various short-, mid- and long-term recommendations were made in WP2 for Eurocode 8.

SHARE (http://www.share-eu.org/), through its partner EUCENTRE, invited – at its expense – the SERIES coordinator, M.N. Fardis, Dr. A. Pecker (GDS) and Dr. E. Carvalho (member of the SERIES External Scientific Committee), to a working meeting in Pavia, on January 8, 2010, in order to exchange information and views. SERIES beneficiaries LNEC and METU, who are also partners in SHARE, participated as well. The close to final outcomes of SHARE were also presented to the same persons during the 15th WCEE in Lisbon in Sept. 2012.
A follow-up meeting is planned for October 2013 at the JRC, where the same persons will be invited.

2.13 PERPETUATE - Performance-based approach to earthquake protection of cultural heritage in European and Mediterranean countries

Interaction was also established with FP7 project PERPETUATE “PERformance-based aPproach to Earthquake proTection of cUlturAl heriTage in European and mediterranean countries” (http://www.perpetuate.eu/), which started in January 2010 and ended in December 2012, through SERIES beneficiaries AUTH, NTUA and UL. PERPETUATE developed European Guidelines for the evaluation and mitigation of seismic risk to cultural heritage assets, with innovative techniques for the seismic strengthening of historical buildings and the preservation of unmovable artworks. The project faced the problem both for architectonic assets and artistic assets. Two different scales were considered: (i) assessment of a single cultural heritage asset; (ii) assessment at the territorial scale. Among other topics of PERPETUATE, the following present a common interest with SERIES:

- Shaking table tests in order to define proper limit states and thus damage measures for cultural heritage assets taking into account both human life safety and specific conservation requirements (Deliverable 12 - Results of experimental test on damage measures and reference values to be considered).
- Shaking table tests to investigate the dynamic response of single or two “connected” multi-drum columns (Deliverable 33 - Results of the shaking table and imposed displacements tests).
- Experimental tests on single walls and full scale mock-ups to capture behavior of historic assemblages and effectiveness of strengthening methods (Deliverable 34 - Results of experimental tests on strengthening techniques and guidelines for the design).
- Proposal of reduction factors of rigid foundation impedances in order to account for the decrease of stiffness of flexible masonry foundations due to aging, weathering, or other deteriorating effects (Deliverable 25 - Report on the development of the simplified soil-foundation model);

### 2.14 SAFELAND - Living with landslide risk in Europe: Assessment, effects of global change, and risk management

SAFELAND (2009-2012) “Living with landslide risk in Europe: assessment, effects of global change, and risk management” was a large FP7 integrated research project dealing with the quantitative assessment, management and mitigation of landslide risk in Europe's regions. Interaction with this project was established through the joint beneficiaries of SAFELAND and SERIES, JRC and AUTH. The final goal of the project was to provide end-users and stakeholders with improved harmonized framework and methodology for the quantitative risk assessment, management and mitigation of landslide risk as well as the evaluation of the changing patterns of landslide risk over time. One of the main results of the project was the development of advanced technologies related to the monitoring and early warning of landslides as applied for the creation and updating of landslide inventories and deformation maps providing efficient input datasets for quantitative risk assessment. In this context, an interaction with SERIES is achieved principally in the framework of “WP13- Advanced Sensing, Data Processing and modeling” concerning the development of monitoring technology, especially early warning systems and remote sensing techniques.

### 2.15 REAKT – Strategies and tools for real time earthquake risk reduction

FP7 on-going project REAKT “Strategies and Tools for Real Time Earthquake Risk Reduction”, which started after SERIES in September 2011, aims to develop methodologies that will enhance the quality of information provided by earthquake forecasting, early warning and real-time vulnerability systems, as well as establishing best practices for how to use all of this information in a unified manner. Three participants of REAKT (www.reaktproject.eu/) are also beneficiaries of SERIES (AUTH, EUCENTRE, KOERI). Among other topics of REAKT, the following present a common interest with SERIES: Work Package WP7- Strategic Applications and Capacity Building, which primary objective is to evaluate the effectiveness of Early Earthquake
Warning (EEW) and real-time risk assessment procedures in reducing seismic risk to various industries, infrastructures, and structures of strategic interest. Within the framework of EEW, research activity focuses among others in implementing new sensor types and developing appropriate instrumentation, monitoring and control techniques as well as modeling tools capable of optimizing the use of the real-time information in the decision-making procedures including realistic estimates of the uncertainties involved.

2.16 UREDITEME - Upgrading of research equipment for dynamic testing of large scale models

The FP7 project Upgrading of Research Equipment for Dynamic Testing of large scale Models, started one month after SERIES and lasted from April 1, 2009 to March 31, 2012, under EC Grant Agreement No. 230099. The main goals of the project were: to improve IZIIS’s RTD capacities in seismic risk reduction and protection of engineering structures (an integral triaxial system for testing soil specimens under static and dynamic loading, as well as new digital controller for the IZIIS shake table were purchased and installed); strengthening of cooperation of IZIIS activities with network partners; Improvement of the IZIIS’s human resources, research potential and dissemination of the project achievements through workshops, training seminars, bilateral visits and technical meetings. Apart from IZIIS – coordinator and main beneficiary of the UREDITEME project –, three more SERIES beneficiaries (JRC, UNIVBRIS and LNEC) participated in the networking activities of the project.

Interaction with SERIES was established through bilateral visits and exchange of experience and know-how in the field of shake table tuning, control and testing, geotechnics, as well design and construction of laminar box for testing large geo-models on shake table. Six young researchers from IZIIS made short-term visits to LNEC. At the end of the project, a workshop on “Seismic Research Testing Facilities in Earthquake Engineering” and a training seminar for young scientists “Capabilities of experimental facilities toward seismic risk reduction” were organized, attracting participants from SERIES beneficiaries LNEC and NTUA.
3 Significant Results

Networking and liaison with international (WFCREE, NCREE, Tongji Univ., US NSF centres PEER, MCEER and MAE, US-NEES, E-DEFENCE, fib), European (EAEE, CEN/TC250/SC8, EEPI) and national (ReL UIS, UK-NEES) networks in earthquake and structural engineering was intense and very fruitful. Moreover, networking with a new entity, ERNCIP started with the participation of ERNCIP at the General Committee meeting in Istanbul and proved to be fruitful during the 3rd period of the project.

Liaison with European organisations, in particular, was instrumental in the great success of the open calls for TA proposals. These calls were publicized via the normal communication channels of EAEE and through circular e-mails (a large number of the addressees were related to CEN/TC250/SC8 or fib). Besides, as noted above, liaison with UK-NEES provided valuable input to Task NA1.1 regarding SERIES’s Distributed Database, and liaison with PEER provided valuable input to Task NA1.5 regarding SERIES’s Database of existing test results.

Interaction with past FP6 or FP7 projects that finished during SERIES was replaced by initially unforeseen networking with new FP7 projects, which started after SERIES.