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LIQUEFACT

Assessment and mitigation of liquefaction potential across Europe: a holistic approach to protect structures/ infrastructure for improved resilience to earthquake-induced liquefaction disasters.

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Participant	Name	Country
ARU (Coordinator)	Anglia Ruskin University Higher Education Corporation	United Kingdom
UNIPV	Universita degli Studi di Pavia	Italy
UPORTO	Universidade do Porto	Portugal
UNINA	Universita degli Studi di Napoli Federico II.	Italy
TREVI	Trevi Societa per Azioni	Italy
NORSAR	Stiftelsen Norsar	Norway
ULJ	Univerza v Ljubljani	Slovenia
UNICAS	Universita degli Studi di Cassino e del Lazio Meridionale	Italy
SLP	SLP Specializirano Podjetje za Temeljenje Objektov, D.O.O, Ljubljana	Slovenia
ISMGEO	Istituto Sperimentale Modelli Geotecnici Societa a Responsabilita Limitata	Italy
Istan-Uni	Istanbul Universitesi	Turkey



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Glossary

Acronym	Description
CA	Consortium Agreement
DoW	Description of Work
EC	European Commission
EEAB	External Expert Advisory Board
EILD	Earthquake Induced Liquefaction Disaster
GA	Grant Agreement
PM	Project Manager
PC	Project Coordinator
PO	Project Officer
WP	Work Package
WPL	Work Package Lead

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1. Summary for publication

1.1 Summary of the context and overall objectives of the project

Recent events have demonstrated that Earthquake Induced Liquefaction Disasters (EILDs) are responsible for tremendous structural damages and fatalities causing in some cases half of the economic loss caused by earthquakes. With the causes of liquefaction being substantially acknowledged, it is important to recognize the factors that contribute to its occurrence, to estimate hazards, then to practically implement the most appropriate mitigation strategy considering the susceptibility of the site to liquefaction, the type and size of the structure. The LIQUEFACT project addresses the mitigation of risks to EILD events in European communities with a holistic approach. The project deals not only with the resistance of structures to EILD events, but also with the resilience of the collective urban community in relation to their quick recovery from an occurrence. The LIQUEFACT project sets out to achieve a more comprehensive understanding of EILDs, the applications of the mitigation techniques, and the development of more appropriate techniques tailored to each specific scenario, for both European and worldwide situations.

Introduction, Goal and Purpose of this document

The LIQUEFACT project is a collaborative project involving 11 partners from 6 different countries (UK, Italy, Portugal, Slovenia, Norway and Turkey) including representation from 4 EU Members States and is organised in three phases (Scoping, Research and Implementation) across nine work packages (WPs), each of which encapsulates a coherent body of work. The first 7 WPs highlight the major technical activities that will take place throughout the project and have been scheduled to correlate with one another. The final 2 WPs (WP8 and WP9) are the continuous activities which will take place throughout the duration of the project.



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In order to ensure the smooth running of the project for all project partners management structures and procedures are necessary to facilitate effective and efficient working practices. Following the management information included in the Grant Agreement (GA) and its annexes, the Consortium Agreement (CA), Commission rules as contained in the Guidance Notes and organisational Risk Management policies and procedures including Corporate Risk Strategy, Policy and Guidance and Health and Safety Policies this manual highlights important procedures to be carried out in order to monitor, coordinate and evaluate the management activities of the project.

Goal: This document aims to provide a summary description of activities and progress of all LIQUEFACT project partners between Months 1 and 7 (May 2016 – November 2016), highlighting completed deliverables and milestones.

1.2 Work performed from project commencement in May 2016 – November 2016

Anglia Ruskin University (ARU)

Since project commencement in May 2016 members of the project coordination team at ARU have been diligently working to support project partners in the facilitation of budgetary and time management processes in relation to pre-financing payments, timesheet reporting and deliverable progress. Through initiation of successful collaboration and communication mechanisms to lay the foundations for successful project completion and instil peer-supported learning and development towards research and innovation activities.

The organisation and management of the LIQUEFACT Kick-Off Meeting hosted by ARU in Chelmsford, UK on the 25th and 26th May 2016 successfully engaged all project partners to build personal and professional relationships amongst work package leaders and provide the opportunity to discuss and plan for project reporting and work package tasks across the first 6 months of the project.

ARU and partners have additionally established a strong and supportive external advisory board to provide independent appraisal and advice throughout the longevity of the project, enhancing external communication and dissemination activities and providing quality assurance procedures are adhered to. It is anticipated that advisory board members will also play an important role in engaging awareness of the LIQUEFACT project amongst external groups including additional academic, business and community spheres.

In October 2016 members of the team at ARU joined partners in hosting and presenting at the first stakeholder/end-user workshop in Ferrara, Italy. This well attended and engaging conference was further followed by successful Project Management and Advisory Board Meetings to discuss detailed project management planning and work package needs. With break-out groups centring on specific deliverable and research needs to complete upcoming tasks.

Ongoing, regular internal management meetings with all ARU project staff have enabled clear lines of communication and support amongst researchers and management members, and this has been



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additionally replicated in the organisation of monthly project consortium meetings hosted by ARU online via web conferencing software to enable consistent updates amongst partners.

ARU has also successfully delivered and uploaded all WP1 and WP9 deliverables (D1, D40, D41, D3, D42, D55, D4 and D43) with input from project partners and within agreed timeframes. Through an intensive investigation of existing research in the community resilience field ARU identified additional areas of research outside of the original project proposal in order to assess the resilience, vulnerability and adaptive capacity of communities. As a result the Fuzzy Cognitive Map (FCM) method has been identified and utilised to allow project partners to represent complex systems and design models to investigate further EILD inter-relationships.

ARU continues to develop, amend and modify ongoing working documents to support the consortium by reflecting emerging issues identified by project partners and the expert advisory panel to safeguard project success.

[Universita degli Studi di Pavia \(UNIPV\)](#)

UNIPV/Eucentre team has been mainly involved in the activities of **WP2 *European Liquefaction Hazard Map (Macrozonation) and Methodology for Localized Assessment of Liquefaction Potential (Microzonation)***.

Special efforts have been focused on Task 2.1 *Ground characterization at the four European testing sites* both in coordinating the partners involved in this task and in conducting the activities on the Italian site, located in Emilia region. This is due to the fact that this task (and the associated Deliverable 2.1) must be completed within 9 months from the starting date of the LIQUEFACT Project. Guidelines for geological-geotechnical characterization of liquefiable ground at the four European testing sites have been developed by UNIPV/Eucentre and provided to other partners of Task 2.1.

The Municipality of Cavezzo in Emilia-Romagna Region has been chosen as Italian case study after meetings with the Italian local authorities, in particular the Emilia-Romagna Administration and the Municipality of Cavezzo. Liquefaction phenomena occurred during the 2012 seismic sequence in Cavezzo. Geological information and geotechnical data of this area have been collected and stored in a GIS database. A complementary investigation campaign, including in situ geotechnical and geophysical tests, has been planned. Currently, contracts with companies specialised in geotechnical and geophysical site investigation are being finalized.

UNIPV/Eucentre started also activities of the other tasks of WP2, namely Task 2.2, 2.3, 2.5 and 2.6. An in depth literature review of previous related research on liquefaction susceptibility and hazard assessment at a regional scale for ground shaking has been carried out to define a methodology for the assessment of liquefaction hazard at the European scale (Task 2.5). The objective is to develop a liquefaction hazard map that will allow identifying territories that are expected to experience severe liquefaction in case of strong ground shaking. The partition of European territory will be carried out at a scale compatible with the resolution of the available geological maps (macro-zonation). It will be



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useful for prioritization of ground improvement interventions in countries/regions that are vulnerable to this problem.

The methods used for the assessment of liquefaction susceptibility and hazard can be divided in three main groups: knowledge-driven, data-driven and the simplified methods. Among these, the knowledge-driven methods characterized through an Analytic Hierarchy Process (AHP) technique seem to be the most appropriate at the European scale. Knowledge-driven methods are based on a subjective assignment of a liquefaction susceptibility factor rated by experience (based on the knowledge on past liquefaction occurrences and their causal factors within a given area, an expert assigns weights to certain combinations of factors).

For the application of the liquefaction hazard assessment methodology, the identification of the controlling factors (*predisposing* that is liquefaction susceptibility and *triggering* that is severity of expected ground motion) at the European scale has been implemented. The following geological and seismological data for Europe have been collected ([Task 2.2](#)):

- International Hydrogeological Map of Europe at a scale of 1:1,500,000 (IHME1500) (Duscher et al., 2015): it contains information about groundwater resources characterised by a basic aquifer typology and the lithology of the deposits;
- Digital Elevation Model over Europe (EU-DEM) and derived parameters to obtain a topographic characterization of the territory which helps defining areas susceptible to liquefaction;
- Probabilistic seismic hazard maps for Euro-Mediterranean region as developed by the European SHARE Project.

The acquired data have been integrated and harmonized under a GIS environment. Development of a homogeneous GIS-based dataset was initiated.

To construct the catalogue of historical liquefaction occurrences ([Task 2.3](#)), a thorough literature review was initiated to identify existing databases for specific areas (e.g. CEDIT for Italy, DALO for Aegean territory), studies, reports and tales concerning earthquakes, chronicles and diaries, archival documentation and seismic bulletins, containing historical information regarding manifestation of liquefaction-related phenomena in Europe, including sand ejecta and sand boils, soil settlements and lateral spreading, ground and structural failures. The research focuses on countries in Europe characterized by large seismic hazard.

A literature review was also started to identify guidelines for seismic microzonation available at international, national and regional level to be used as starting point in [Task 2.6](#).

UNIPV/Eucentre have performed activities also in **WP1 Stakeholder Requirements and Industry/Research Gaps**, involving stakeholders/end-users of the LIQUEFACT Project. From Pavia, more than 20 letters of invitation to be part of the LIQUEFACT project as stakeholders/end-users were sent to governmental organizations, professional associations, regulatory institutions, research organization, owners of critical buildings and infrastructure, civil protection agencies, GIS companies, etc. Specific meetings with strategic stakeholders were undertaken, as previously mentioned.



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Finally UNIPV/Eucentre were active in **WP9 Consortium/Project Management**, being Prof. Dr. Carlo G. Lai of University of Pavia Technical Lead of the LIQUEFACT Project, and also in **WP8 Dissemination/Exploitation**. A crowdfunding initiative named “Geo-Explorer Park” has been launched with the support of the University of Pavia through the crowdfunding platform “Universitiamo”. The goal of the project is to raise funds for the realization of a physical and virtual educational laboratory to reproduce and simulate geo-related phenomena occurring in a territory during a strong earthquake including soil liquefaction.

Universidade do Porto (UPORTO)

Since May, the team at the University of Porto has been actively involved in the activities of the project, mainly on WP1 and WP2, but also in preparing WP3.

The work developed by UPorto comprised scientific, technical, administrative and managerial tasks.

WP1: A significant number of national institutions and public organisations, as well as a few private companies were contacted and informed through meetings, phone calls and mailing letters, of the concept and relevance of the LIQUEFACT project within the scope of their interests, in attempts to establish new partnerships and define new stakeholders and end users to the project. At present, two strong partnerships have been set up: with the Portuguese Laboratory for Energy and Geology (LNEG) and with Teixeira Duarte (TD), a well-known and recognised Portuguese geotechnical contractor. In terms of local authorities, only the municipalities of Montijo and Barreiro have accepted our invitation and agreed to work with Liquefact team. The National Association of Chartered Engineers as well as the Portuguese Society of Earthquake Risk have responded positively to our invitation to participate in the project.

WP2: An extensive work has been made on this work package, focusing on the study of the geological, geomorphological, hydrogeological and seismological setting of the Greater Lisbon area. This study was initiated by data gathering and collection of the existing available geological and geotechnical information. In Portugal, this information is not readily available to the public, not even to universities or specialised institutions, despite the high volume of site investigation reports known to exist. To resolve this issue, the partnerships with both LNEG and TD proved very fruitful: on the one hand, LNEG holds the largest library of national geological and geotechnical reports, particularly prior to the 90's, while on the other hand, TD is one of the most recurrent geotechnical contractor, corresponding to 80% of the available reports. This data has been systematically analysed and geo-referenced, for the purpose of identifying the most suitable location for the Portuguese experimental site of LIQUEFACT.

A preliminary site investigation at the municipality of Montijo, south of Lisbon, was shortly after discarded, since it was found to have limited liquefaction susceptibility. Subsequently, and after some interaction with other municipalities, the experimental site was finally established at the municipality of Vila Franca de Xira, within the grounds of the Lezíria Grande, owned by a hydro-agricultural cooperative. A vast area, where a number of relevant and potentially critical



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infrastructures are located, has recently been made accessible and open to our investigation activities, enabling us to carry out the necessary complementary geotechnical investigation campaign and to prepare a microzonation map of an extensive area. The main field works and tests on this experimental site will take place in mid-November, and possibly the first week of December, and will be followed by a preliminary laboratory soil characterisation. These works will provide the basis for the Portuguese report on the first deliverable of WP2.

WP3: The preparation of this work package has been initiated with an extensive bibliographic review on the most suitable methods to approach soil-structure interaction. Numerical analysis have already been implemented for the study of the best approach to this task.

[Universita degli Studi di Napoli Federico II \(UNINA\)](#)

During the reporting period from 1st May 2016 to 30th November 2016, the partner UNINA has been involved in activities within WP1, WP2, WP8 and WP9 only. WP3 and WP4 (the latter led by UNINA), are expected to start on the 1st December 2016, but preparatory activities concerning these WPs have been carried out as well. In the following, a short report of the main activities undertaken in this reporting period is presented.

Activities within WP1/WP8

As part of activities towards stakeholder and industry (WP1), the organization of the Stakeholder meeting and round table required preliminary talks with Emilia-Romagna Region that hosted the stakeholder meeting and several more individuals as representatives of local authorities, civil protection, professional groups, academic and research bodies, association of citizens. These were conducted by phone calls, tele-meetings and meetings in person when possible.

The stakeholder workshop at the seat of Emilia-Romagna Region in Bologna on the 3rd October was attended by 3 representatives of UNINA: Alessandro Flora, who held a lecture on “Mitigation of liquefaction susceptibility”, Emilio Bilotta, who introduced to the stakeholders the activities of WP4, and Francesco Silvestri.

The morning session of the workshop, that included presentations oriented to a public mostly made of practitioners, was also part of the project dissemination activities (WP8).

Activities within WP9

Delegates of UNINA (Alessandro Flora, WP4 coordinator, and Emilio Bilotta) have attended the kick-off meeting in Chelmsford on 25th-26th May, presenting the key activities and tasks of WP4 and entering into closer relation with the activities of the other WPs.

Later on, in the days following the stakeholder meeting in Bologna, the Partners Workshop (4th October), the Advisory Group and Project Management Meeting (5th October) and the Selena Training course (6th October) were held in Ferrara. These meetings were attended by Alessandro Flora as WP4 coordinator and Emilio Bilotta who is active in the coordination of the UNINA tasks. The Selena Training course was also attended by two recently appointed PhD students of the University of Naples that are going to collaborate on the project.

Regular tele-meetings are organized by ARU concerning the ongoing activities within the consortium, the latest was held on the 7 November and attended by Alessandro Flora and Emilio Bilotta for UNINA.



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Activities within WP2/WP4 (preliminary)

With the occasion of the meetings in Emilia-Romagna Region, a team of UNINA visited a few locations in the surrounding of Ferrara that might be possibly eligible for the trial site. Samples of liquefiable sand deposits that were stored from previous ground investigations were then collected and taken to the UNINA laboratories in Naples for soil characterization. A site visit with the partner TREVI is already scheduled for November 25 for a detailed definition of the trial site in the Emilia-Romagna Region.

Activities within WP4 (preliminary)

A call for tender for purchasing a cyclic simple shear apparatus at UNINA was launched in November, 2016 and it will be finalized by next month.

Preliminary talks with the partner ISMGEO have been conducted to define in deeper details the centrifuge testing programme. UNINA personnel will be directly involved in the experimental testing activities, and will work in a tight connection with ISMGEO personnel.

Activities within WP3 (preliminary)

Preliminary talks with UPORTO were undertaken in person with the occasion of the project meeting in Ferrara to discuss a common strategy to be adopted for laboratory testing and numerical modelling. Further discussion is ongoing by means of tele-meetings.

[Trevi Societa per Azioni \(TREVI\)](#)

During these firsts 7 months of the LIQUEFACT project, a major effort was undertaken by TREVI through WP1 and WP8. Many preliminary activities were started for WP4 as well, and special attention was given to the evolution of WP2 (which does not directly involve TREVI).

TREVI recruited most of its key staff, paying attention to both technical and economical/ bureaucratic aspects that were properly set since the beginning of the project.

Of course the kick off meeting held in UK in May and the Workshop held in Italy in October were very useful in order to meet all the people strictly involved in the project. This aspect cannot be considered of secondary importance, since, in our opinion, in order to achieve such a challenging goal, it is necessary to have a "well melted" crew.

As far as WP2 is concerned, we followed the decisional path regarding the choice of the location for the large-scale Test Field that will be set in Emilia Romagna; an on-site visit will be soon performed in order to hopefully finalize the choice. We strongly believe that, although WP4 activities belonging to the test field are due to start in month 14 (June 2017), the municipality must be contacted as soon as possible.

A massive effort of coordination was carried out together with UNICAS, with which we share the majority of activities related to WP8. Subsequently, we decided that the LIQUEFACT website and intranet is going to be fully managed by UNICAS while TREVI is in charge of all Social Media activities.

Obviously all partners must be involved in all the activities related to dissemination and exploitation activities; up to now all social media and websites have been updated with information regarding



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Bologna and Ferrara workshop, with a TREVI Group Journal article concerning the project and with link to a video showing a Liquefaction event which occurred in Santa Vittoria in Matenano (Fermo - Italy) during the earthquake of 30th October.

Some minor activities regarded WP9, in particular some materials were supplied to ARU in order to finalize Deliverables.

[Stiftelsen Norsar \(NORSAR\)](#)

The SELENA Open Risk Package (short for seismic loss estimation using a logic tree approach) which will provide background knowledge and which will contribute to the development of the LIQUEFACT Reference Guide (LRG) software toolbox, is one of the flagship developments of NORSAR. The LRG software toolbox to be developed during the LIQUEFACT project will provide civil engineers and relevant stakeholders' guidance in making informed assessments on the feasibility and cost-benefit of applying certain liquefaction mitigation techniques. NORSAR plays a key role in the consortium which mainly consists in integrating the knowledge and methodologies from the outputs of the various LIQUEFACT consortium partners into an easy-to use LRG software. In this respect, NORSAR is engaged to undertake several tasks aimed at better understanding the needs and addressing the various challenges, in order to come-up with effective solutions that would successfully lead to development of the LRG software toolbox. The LRG toolbox will be implementable for an individual level (single structure/infrastructure) and on a region/city level (i.e., for an urban area with respect to GIS-based outputs) with procedures for calculating socio-economic impacts and proposing risk reduction and resilience improvement strategies.

In the first part of the project duration, the NORSAR team has been engaged in the following activities:

1- Literature review/investigation and analysis: NORSAR team has conducted a thorough review of past and ongoing research and innovation projects that are proposing concepts and solutions relating to liquefaction-induced risk. The literature review and investigation activity has covered the analysis of the current state-of-the-art on available earthquake risk/resilience assessment software tools, and on how the module of liquefaction-induced risk assessment has been or could be implemented, e.g. the HAZUS-MH (FEMA 2003), PREMISERI103 (FP7-SME), etc. The investigation has also included the existing building standards and the adopted design/assessment methodologies for structures and infrastructures located in areas with high liquefaction susceptibility.

2- Stakeholder workshop: NORSAR team has participated in the workshop and developed a network with some various stakeholder and end-users for the envisaged LRG software toolbox. This direct interaction has permitted to understand lessons learnt from past disaster, type of barriers that are considered the most frequently occurring, the needs for best mitigation planning practice: e.g. in estimating the potential risk (in terms of building damage and definition of various level of liquefaction-induced damage) that can be induced by liquefaction, and how liquefaction-induced risk can be avoided or reduced.



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3- LIQUEFACT consortium partners' first face-to-face meetings: NORSAR team has attended the consortium partners' first face-to-face meetings (Chelmsford on May 25/26, 2016, and Ferrara on October 4/5, 2016), where several issues and challenges have been discussed in order to get clear directions on how the various work packages should be developed. The meetings have allowed establishing a common working practice to ensure that activities undertaken in various work packages (especially WP2, WP3, WP4 and WP5) produce outputs that are directly useable for an effective and successful LRG software development.

NORSAR team has shared the outcomes of the literature review that has been conducted and aimed in identifying the various barriers that can limit an effective liquefaction mitigation planning, and explore the current state-of-the-art methodologies that can be considering for the LRG software development.

4- Analysing outcomes from the various face-to-face meetings: NORSAR team has started analysing the various outcomes of the consortium partners' first face-to-face meetings (as well as of the stakeholder meeting) to overcome the various issues and barriers that have been identified, in order to ensure an effective LRG software toolbox development.

5- One-day workshop on Earthquake Loss Estimation (ELE) using the open-source tool SELENA – Towards addressing earthquake-induced liquefaction (Ferrara on October 6, 2016):

The LRG software toolbox will be a fully working prototype that builds on SELENA open risk package toolbox, whose development started in 2004 under the umbrella of the International Centre for Geohazards (ICG) in collaboration between NORSAR (Norway) and the University of Alicante (Spain). The envisaged LRG software toolbox will be developed as an extendable module that can be integrated with SELENA (SELENA-LRG).

In this respect, NORSAR team has taken an initiative in conducting a one-day training course/workshop for the LIQUEFACT consortium partners. This training workshop has provided the partners with a clear understanding on the different steps in implementing seismic risk assessment and covering the various components from hazard analysis, vulnerability, and risk in terms of physical damage, socio-economic losses and fatalities.

5- Developing glossary: NORSAR team has been contributing in developing a glossary of key terms used in the various work packages. Providing a one detailed definition for each of these key terms would provide end-users with a clear understanding and an effective implementation of the envisaged LRG software toolbox.

[Univerza v Ljubljani \(ULJ\)](#)

Faculty of civil and geodetic engineering University of Ljubljana cooperates in LIQUEFACT project with two different institutes: Chair of Soil Mechanics with Laboratory and Chair of Structural and Earthquake Engineering.



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In the course of first months of the projects, the project team was established that consists mostly of existing staff (senior researchers and two post-doc students that recently concluded PhD study) and one newly employed PhD student. Most of the time was devoted to the review of literature and collecting the historical data on liquefaction in Slovenia and neighboring countries. We have attended the project kick-off meeting at the end of May 2016 (2 persons) in Chelmsford, UK, workshop in Bologna on 2.10.2016 and project meeting in Ferrara on 3 and 4 October 2016 (3 persons). It has been decided that the next project meeting will take place in Ljubljana in mid-March 2017.

The main task of the University in Ljubljana, together with another Slovenian partner (SLP) during the first 9 months of the project is the selection of the test field(s), organization and execution of in-situ and laboratory tests (within the scope of WP2) that will be used in the later stages of the project to test the developed methodologies for the assessment of community resilience to EILD. Our test site will present one of four test sites across Europe together with Italy, Turkey and Portugal. Two test sites in Slovenia are proposed, one at the location of hydropower plant Brežice on the lower Sava River where some previous data exist and at the coast of Bohinj Lake in the Alps where during 1998 earthquake a failure along the shoreline was observed and some authors guessed that this was a consequence of the ground liquefaction. No data on the ground conditions exist for this site.

The test field near the hydropower plant (HPP) Brežice was geotechnically investigated already during the design of the HPP. Some in-situ and laboratory investigations were made also to estimate the susceptibility to liquefaction of the soil. Cone penetrometer (CPT), seismic dilatometer test (SMDT) and dynamic probing (DP) was performed in the field, while in laboratory focus was on index properties, soil water content, density and cyclic simple shear tests. Location seems to be extremely interesting, because we might have the opportunity to make ground characterization of dry sandy soil layer before flooding of the reservoir and additional ground characterization of the same soil layer after measurements during the project when the soil layer susceptible to liquefaction will be submerged.

Recently we have devoted energy and time to plan and organize ground investigation in the second test field at the shoreline of Lake Bohinj with the aim to investigate lacustrine sediments (chalk) under moraine deposit. The test field is located within the Triglav National Park, by which it was necessary to obtain appropriate approval because of the strict nature protection of that area. Field investigation will include 4 to 5 boreholes with SPT and Menard pressuremeter tests, CPTU and SDMT measurements. Geophysical measurements (MASW, electrical tomography, "cross hole") will complement the in-situ investigation campaign. The in-situ tests will start on 16 November 2016.

The group from Chair of Structural and Earthquake Engineering takes part in WP3 that started at the beginning of November 2016.

[Universita degli Studi di Cassino e del Lazio Meridionale \(UNICAS\)](#)

According to the program, the University of Cassino (UNICAS) is involved with 48 months persons subdivided in the following work packages:



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- WP1: 6 months*person
- WP2: 2 months * person
- WP3: 2 months*person
- WP5: 2 months*person
- WP7: 32 months*person
- WP8: 2 months*person
- WP9: 2 months*person

Much of the effort of UNICAS in the first months has been spent in developing the end stakeholder/user group and in preparing the fundamental tools for dissemination. With regard to the former issue, a kick off meeting has been organized in Bologna, which has been attended by 205 persons, private professionals or representative of public institutions, consultant firms, research and academic institutions. The organization of this event has included the following activities:

- 37 qualified stakeholders have been privately contacted by mail to invite them at the event
- Prepare the program consisting of 22 presentations
- Hold two presentations, one reporting an overview of the existing standards on seismic liquefaction, the other describing the activities to be carried out for WP 7.
- Advertise the event by diffusing a brochure
- Prepare the location of the venue with posters and organize a coffee breaks and lunch
- Disseminate the event via WebTV (Lepida TV) and social networks
(<http://videocenter.lepida.it/videos/video/2508/?live=true>)

With regard to the dissemination activities a web site has been created (www.liquefact.eu) visited until now by 1040 users (from 19th September, 2016), together with an intranet

(www.intranet.liquefact.eu) open to all partners to speed up the exchange of information.

Dissemination has been also promoted forming via different social networks (Facebook, YouTube, LinkedIn, Twitter, Google +). Additionally, an overall report on the project has been published in the TREVI group journal.

Apart from these activities, some preparatory work has been done for the validation of the methodologies implemented during the project (WP7). In particular, a relation has been started with the University of Canterbury at Christchurch (New Zealand) to study the effects of liquefaction during the seismic sequence in 2011. This cooperation has led to the exchange of information and the selection and cataloguing of data regarding the occurrence of liquefaction phenomena, the subsoil properties and damage on buildings.



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Similar work has been done for the 2012 Emilia Romagna earthquake. Here a collaboration has been started with Eucentre and University of Pavia. The data regarding different towns where extensive liquefaction phenomena were recorded have been taken and processed.

For both cases the short term program consists in developing an algorithm to speed up the processing of data, in order to reconstruct the subsoil stratification, investigate the liquefaction susceptibility at the different levels and quantify the effects at the ground level with the most advanced predictive tools. Finally, a straight comparison with the damages observed on buildings will be carried out to check the validity of the existing methodologies and recalibrate them if necessary. The latter work will be carried out in parallel with ARU, interested in assessing the resilience of communities affected by liquefaction.

[SLP Specializirano Podjetje za Temeljenje Objektov, D.O.O, Ljubljana \(SLP\)](#)

In the period of first months of the projects, the project team was established that consists from existing SLP staff (Gorazd Strniša, Ivan Lesjak, Danijel Zakonjšek and Matevž Lesjak).

Most of the time was devoted to the review of literature and collecting the historical data on liquefaction in Slovenia and neighboring countries. We have attended the project workshop in Bologna on 2.10.2016 and project meeting in Ferrara on 3 and 4 October 2016 (2 persons).

We start with new equipment for measurement shear waves (VS) and primary waves (VP) together with DMT equipment and we start to experiment with CLiq v.2.0 – CPT liquefaction software.

Within the first 9 months of the project, the main SLP Ljubljana task (together with University of Ljubljana) was the selection of the test field(s), organization and execution of in-situ and laboratory tests (within the scope of WP2) that will be used in the later stages of the project to test the developed methodologies for the assessment of community resilience to EILD.

Our test site will present one of four test sites across Europe together with Italy, Turkey and Portugal. Two test sites in Slovenia are proposed, one at the location of hydropower plant Brežice on the lower Sava River where some previous data exist and at the cost of Bohinj Lake in the Alps where during 1998 earthquake a failure along the shoreline was observed and some authors guessed that this was a consequence of the ground liquefaction. No data on the ground conditions exist for this site.

The test field near the hydropower plant (HPP) Brežice was geotechnically investigated already during the design of the HPP. Some in-situ and laboratory investigations were made also to estimate the susceptibility to liquefaction of the soil. Cone penetrometer (CPT), seismic dilatometer test (SMDT) and dynamic probing (DP) was performed in the field, while in laboratory focus was on index properties, soil water content, density and cyclic simple shear tests. Location seems to be extremely interesting, because we might have the opportunity to make ground characterization of dry sandy soil layer before flooding of the reservoir and additional ground characterization of the same soil layer after measurements during the project when the soil layer susceptible to liquefaction will be submerged.



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Recently we have working mainly to plan and organize ground investigation in the second test field at the shoreline of Lake Bohinj with the aim to investigate lacustrine sediments (chalk) under moraine deposit. The test field is located within the Triglav National Park, by which it was necessary to obtain appropriate approval because of the strict nature protection of that area. Field investigation will include 4 to 5 boreholes with SPT and Menard pressuremeter tests, CPTU and SDMT measurements.

We already select the most suitable contractors for Geophysical measurements and borings. Geophysical measurements (MASW, electrical tomography, "cross hole") will complement the in-situ investigation campaign. The in-situ tests will start on 16 November 2016.

[Istituto Sperimentale Modelli Geotecnici Societa a Responsabilita Limitata \(ISMGEO\)](#)

ISMGEO has been involved in the following topics:

WP1

- Internal activities to finalize the organization of the kick off meeting (25th of May).
- Participation in the virtual meetings with other Italian partners (UNINA, UNIPV, UNICAS, Trevi) to identify the potential Italian stakeholders.
- Meetings in Bologna with UNINA and UNIPV to illustrate the scope of the project to the Geological and Seismic Service of the Administration of Emilia Romagna Region (GSS – ER) and to identify new stakeholders among the local administrations involved by the Emilia 2012 earthquake.
- Contribution to the organization of the 3rd October workshop.
- Organization and participation to the Ferrara meetings in October.
- Contribution to the organization of the stakeholders meeting in Bologna and discussion with stakeholders.

WP2

- Participation in virtual meetings and face to face meetings with UNIPV, UNINA, GSS – ER, to identify the municipality of where to focus the case study in Italy.
- Meetings with UNIPV, UNINA, GSS – ER and the municipal officers of Cavezzo and San Felice sul Panaro municipality to identify the sites where the trials could be performed.
- Collection and analysis of existing data: geomorphological charts, geological maps, hydrogeological information, seismic micro-zonation, geotechnical investigation, in situ and laboratory tests. Data obtained used to identify homogeneous geological units susceptible to liquefaction.
- Contribution to planning complementary ground investigation campaigns. Among the in-situ geotechnical tests that will be included in the complementary ground investigation campaigns are; the cone penetration tests (CPT) with acquisition of the excess pore pressure (CPTu) and the shear wave velocity Vs (SCPTu), flat dilatometer tests (DMT) with acquisition of Vs through the seismic dilatometer (SDMT), standard penetration tests (SPT), pressuremeter tests (PMT). Furthermore, geophysical tests such as spectral analysis of surface waves, SASW, multi-channel analysis of surface waves, MASW, down-hole, cross-



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hole, and electric tomography are also included in the plan of the complementary investigation campaign at the case study sites.

WP8

- Organization and participation (with UNICAS, UNIPV and UNINA, Trevi, UPORTO) to the dissemination meeting in Bologna (3rd of October).

WP9

- Participation to consortium project meetings.

Istanbul Universitesi (Istan-Uni)

In this period of LIQUEFACT Project, our studies are formed in two parts: (1) Stakeholder and End-user's Meeting of Turkish side, and (2) Organizing of Test Sites in Marmara Region.

1. Stakeholder and End-User's Meeting of Turkey

In the first stage of the study, we conducted a meeting with stakeholders and end-users from Turkey. Different stakeholder groups and end users such as Politicians, non-profit relief organizations, including NGOs, governmental organizations at local, municipal and country levels, civil protection agencies, specialty geotechnical construction companies were selected to demonstrate the remarks on different point of views (See Table 1 in Appendix).

Initially, an invitation letter was sent to the participants, afterwards a meeting was conducted in Kadikoy (Istanbul) on October 21st 2016 to introduce the plan and research activities of this project (Table 1 in Appendix). During the meeting, firstly the project was introduced to our Stakeholders and End-Users (Photo 1 and 2 in Appendix), and secondly the Questionnaire (in Appendix) was asked to them. At the end of the meeting, a review of the project as a result of opinions and suggestions of the Stakeholders and End Users was documented (Photo 3 to 5 in Appendix).

Some remarks stated by Stakeholder and End-user's regarding the soil liquefaction are given below:

1. Since the earthquake and earthquake triggered liquefactions in Turkey causes the life and economic losses, research projects should provide applicable solutions
2. Insurance companies are experiencing uncertainties about earthquake triggered liquefaction events
3. Lack of a liquefaction database on National and European scale

Needs of Stakeholder and End-user's for Soil Liquefaction Hazard Mitigation are:

1. There are not enough new techniques on liquefaction in site investigation reports
2. Liquefaction assessment in site investigating reports is not standardized
3. A liquefaction database is required on national and European scale
4. Lack of standardization in relation to structure-soil-earthquake interaction
5. Liquefaction – structure interaction needs to be clarified and remediation against liquefaction and soil improvement techniques should be clearer.

2. Organizing of Test Sites in Marmara Region



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In the first stage of the study, we organized the test sites in Marmara Region. Firstly the locations for test sites we have conducted the local municipalities. Considering the geological and geotechnical criteria, proper sites for liquefaction were determined as Çanakkale, Tekirdağ, Bursa and Istanbul cities (Figure 1). Secondly, scientific methodology to investigate the test sites was alternatively determined. Geophysical and geotechnical research teams were formed. The geophysical tests are selected MASW, Electrical Tomography, Micro tremor, Georadar. Special geotechnical and laboratory tests (such as seismic-cone and cyclic triaxial test) will be carried out and analysed with the geophysical tests. However, to make the research more effective, blasting-caused liquefaction is planning at Çanakkale site similar to Christchurch case. Çanakkale city was built on liquefiable sands and thickness of the sands is approximately 18 meters. Effect of Vs, fines content, PGA and soil improvement techniques on liquefaction-based displacements will be searched by the blasting-caused liquefaction. Number of sites and test details will be clarified following the defining the budget of blasting.

Furthermore, M.Sc. and Ph.D. students will be joined to the project in these stages.

Thirdly a study was begun for subcontracting cost of the site sites.

1.3 Progress beyond the state of the art, expected results until the end of the project and potential impacts (including the socio-economic impact and the wider societal implications of the project so far)

2. Deliverables

Del. no.	Deliverable name	WP no.	Lead beneficiary	Type	Dissemi n. level	Delivery date from Annex 1	Actual delivery date	Status	Comments
D34	LIQUEFACT project website	WP8	UNICAS	WEB	PU	1	2	Not assessed yet	
D1	A report on the challenges to improve community resilience to EILD events	WP1	ARU	REPORT	PU	3	3	Not assessed yet	
D40	Project Management Plan	WP9	ARU	REPORT	CO	3	3	Not assessed yet	
D41	Quality Procedures Manual	WP9	ARU	REPORT	PU	3	3	Not assessed yet	



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D2	Proceedings of the first stakeholder/end-user workshop: including workshop presentations	WP1	UNICAS	<i>OTHER</i>	<i>CO</i>	4	6	Not assessed yet	Deliverable delay agreed by PO via email due to stakeholder meeting held October 2016
D3	Report Outlining a risk based assessment and resilience improvement framework	WP1	ARU	<i>REPORT</i>	<i>PU</i>	6	6	Not assessed yet	
D42	Project Board Management Report 1	WP1	ARU	<i>REPORT</i>	<i>CO</i>	6	6	Not assessed yet	
D55	Data Management Plan v1	WP9	ARU	<i>REPORT</i>	<i>PU</i>	6	6	Not assessed yet	
D4	Detailed user requirements and research output protocols for the LIQUEFACT Reference Guide	WP1	ARU	<i>REPORT</i>	<i>PU</i>	7	7	Not assessed yet	
D43	Periodic Project Progress Report 1	WP9	ARU	<i>REPORT</i>	<i>PU</i>	7	7	Not assessed yet	

3. Milestones

Milest. no.	Milestone title	Related WP(s) no.	Lead beneficiary	Delivery date from Annex 1	Means of verification	Achieved	Comments
1	Comprehensive project scoping complete	WP1, WP8, WP9	ARU	01/11/2016	D34 D1 D40	YES	



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					D41 D2 D3 D42 D55 D4 D43		
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4. Critical implementation risks and mitigation actions

4.1 Foreseen Risks

The following table lists the Risks identified in Annex 1. The table is read-only and it is provided as a reference for the State of Play table below. Risk Number	Description of Risk	Work Packages Concerned	Proposed risk-mitigation measures
1	Insufficient participation of external experts and end users with technical assistance and transfer of knowhow of actual industry needs	1, 7	Specialized meetings with comprehensive involvement and elicitation of national and thematic experts

4.2 Unforeseen Risks

There are no unforeseen critical risks

5. Dissemination and exploitation of results

No scientific publications to date

5.1 Dissemination and communication activities

Type of dissemination and communication activities	Number
Organisation of a Conference	1 x 2 day Kick Off Meeting, UK
Organisation of a Workshop	1 Bologna, 3 rd October 2016
Press release	-
Non-scientific and non-peer reviewed publications (popularised publications)	-
Exhibition	-
Flyers	1 flyer (300 copies) 4 posters (6 copies)
Training	1 SELENA consortium training, 6 th October 2016
Social media	5 (Facebook, YouTube, LinkedIn, Twitter, Google +)



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Website	1 internet and 1 intranet website
Communication campaign (e.g. radio, TV)	http://www.lepida.tv/
Participation to a conference	-
Participation to a workshop	University of Cassino, Oct. 7 th 2016
Participation to an event other than a conference or workshop	-
Video/film	http://videocenter.lepida.it/videos/video/2508/?live=true
Brokerage event	-
Pitch event	-
Trade fair	-
Participation in activities organised jointly with other H2020 project(s)	-
Other	-
Total funding amount	Approximately 8.000,00 €

Type of audience reached In the context of all dissemination & communication activities	Estimated Number of persons reached
Board of professional (Engineers, Geologists, Architects), Expertise Association (AGI)	Approximately 800

6. Gender

Gender of researchers and other workforce involved in the project Beneficiaries	Number Women researchers (all levels, incl. postdocs and PhD students)	Number Men researchers (all levels, incl. postdocs and PhD students)	Number Women in the workforce other than researchers	Number Men in the workforce other than researchers
ARU	2	3	1	-
UNIPV	2	1	-	-
UPORTO	2	3	-	-
UNINA	1	2	-	-
TREVI	-	2	-	-
NORSAR	-	2	-	-
ULJ	-	2	-	-
UNICAS	1	1	-	-



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SLP	-	1	-	-
ISMGEO	-	1	-	-
Istan-Uni	-	3	-	-

Gender dimension in the project

Does the project include a gender dimension in research content? *No*



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Appendix

Table 1. Stakeholder and end-user List of Istanbul University (ISTAN-UNI)

Stakeholder /end user		Contact person	Email
Name	Type (*)		
(Lawmaker of CHP, 25th Period, Grand National Assembly of Turkey)	Politician	Prof. Dr. Haluk Eyidogan	eyidoganh@gmail.com
Chamber of Geophysical Engineers of Turkey	Non-profit relief organizations, including NGOs	Erdal Sahan	erdal.sahan@gmail.com
Kadıkoy-Istanbul Municipality	Governmental organizations at the municipal levels	Menekşe Perdi	meneksetekin@yahoo.com
Zetaş A.Ş.	Specialty geotechnical construction companies	Prof. Dr. Turan Durgunoglu	durgunoglut@zetas.com.tr
Belirti A.Ş.	Specialty geotechnical construction companies	Taner Teoman	taner@belirti.com
AKUT Search and Rescue Association	Civil protection agencies	Çağlar Akgüngör	caglarakgungor@akut.org.tr
ISKI (Istanbul Water and Sewerage Administration)	Owners of critical buildings and infrastructure	Erkan Öztürk	erkanozturk1903@yahoo.com m.tr
Tekirdağ Büyükşehir Municipality	Governmental organizations at regional levels	Sevim Avcı	sevimavci@gmail.com
Nilüfer – Bursa Municipality	Governmental organizations at the municipal level	Güngör Armutlu	gungorarmutlu@nilufer.bel.tr
Earth Sciences Research Department Ministry of Environment and Urbanisation	Governmental organizations at the country level	Cahit Kocaman (Head of Department)	cahit.kocaman@csb.gov.tr
Earth Sciences Research Department	Governmental organizations at the country level	Esra Ezgi Baksi	esraezgi.baksi@csb.gov.tr



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Ministry of Environment and Urbanisation			
Earth Sciences Research Department Ministry of Environment and Urbanisation	Governmental organizations at the country level	Selcan Melike Öztürk	smelike.ozturk@csb.gov.tr
Çanakkale Municipality	Governmental organizations at the municipal level	İbrahim Çoban	cbnibrhm@gmail.com
Kepez (Çanakkale) Municipality	Politician, Member of Municipal Council	Ali Aygün	yebilim@hotmail.com
Yalova Municipality	Politician, Ex-Member of Municipal Council	Murat Uzun	Uzameryalova@hotmail.com
GEOgrup İnşaat A.Ş. (Turkish Representative of Plaxis Software)	Specialty geotechnical construction companies	Müge İnanır	info@geogrup.com.tr
Soil Mechanics and Geotechnical Engineering Society of Turkey	Non-profit relief organizations, including NGOs	Prof. Dr. Feyza Çiniciöğlü	feyzac@istanbul.edu.tr info@zmgm.org.tr
Earthquake Engineering Association of Turkey	Non-profit relief organizations, including NGOs	Assoc. Prof. Dr. Mustafa Kerem Kockar	mkockar@gazi.edu.tr
Sumet Yerbilimleri	Specialty geotechnical construction companies	Erhan İçöz	erhanicoz47@gmail.com



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Photo 1. General View of Stakeholder/End-user's Meeting



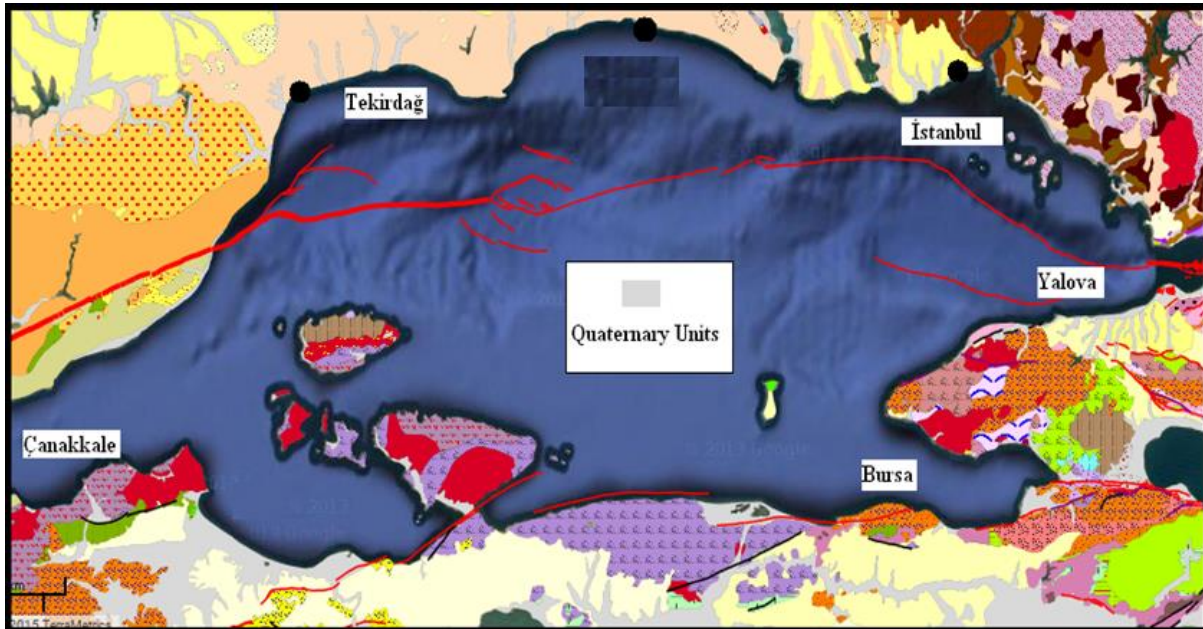
Photo 2. Presentation of Liquefact Project to the Stakeholder/End-user's





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Figure 1. Test Sites and Active faults and Quaternary geology of Marmara Region

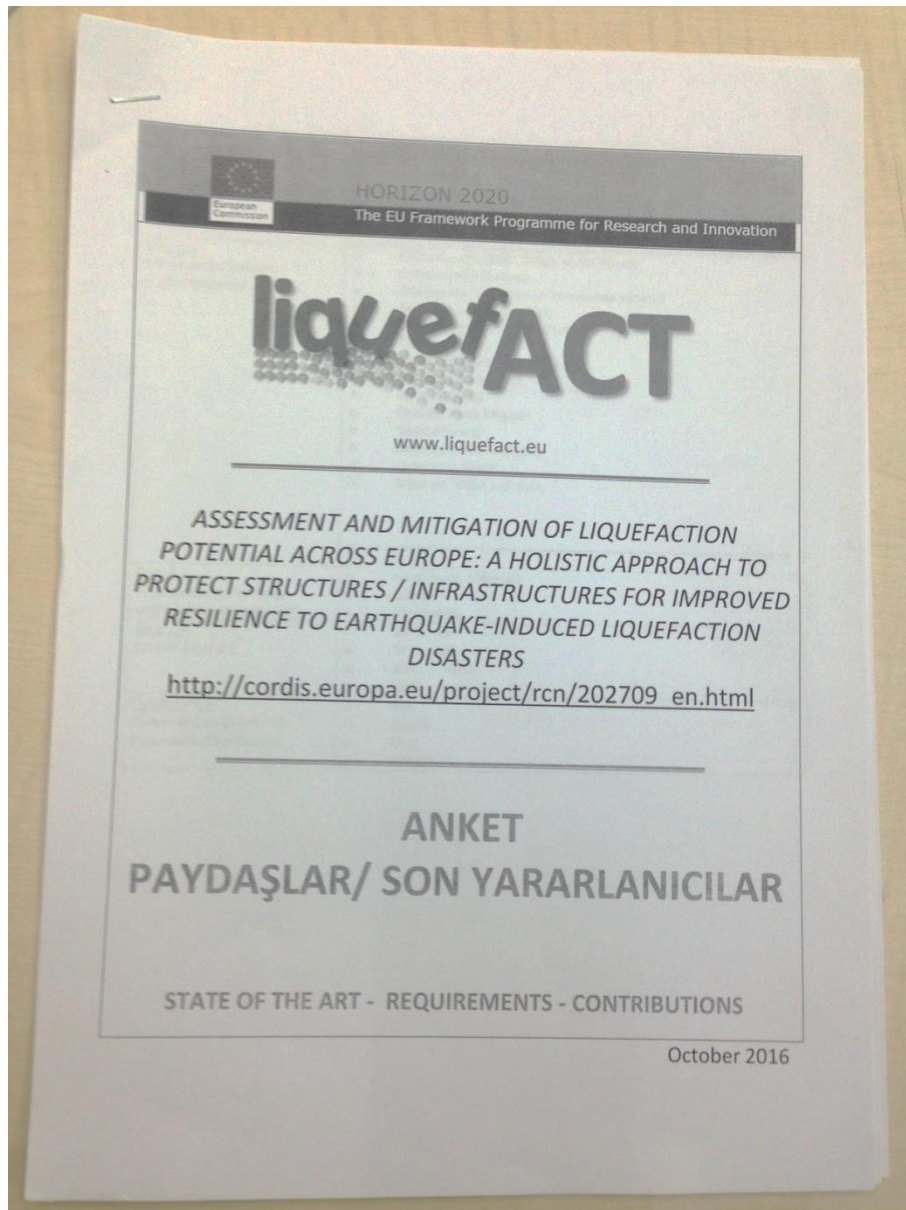




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Examples of Questionnaire to survey the Stakeholders/End-users in Turkey

Photo 1. Cover page of Questionnaire





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Photo 2. Example Questionnaire for Stakeholders/End-users

KISIM 1: KURUM/ORGANİZASYONUNUZ HAKKINDA BİLGİ	
Soru 1.1 Kurumunuzun ismi ?	Samet Herbilimleri Ltd. Şti
Soru 1.2 Kurumunuz nasıl bir organizasyondur ?	<input type="radio"/> kamu kurumu (kent, bölge, ulusal düzey) <input type="radio"/> sivil savunma kurumu <input type="radio"/> Kritik yapılar ve altyapılar konusunda yönetici <input type="radio"/> sivil toplum örgütü (NGO) <input checked="" type="radio"/> Özel Mühendislik Firması/Şirketi <input type="radio"/> Tasarım Firması <input type="radio"/> Geoteknik Danışmanlık Firması <input type="radio"/> GIS konusunda firma <input type="radio"/> Genel Mütehit <input type="radio"/> Özel Geteknik Müşavir <input type="radio"/> Sigorta Şirketi <input type="radio"/> concessionaire company <input type="radio"/> Araştırma Şirketi <input type="radio"/> Diğer ise lütfen belirtiniz:
Soru 1.3 Organizasyonunuz hangi coğrafi düzeyde çalışıyor?	<input type="radio"/> Yerel (kent, bölgesel) <input type="radio"/> Ulusal <input checked="" type="radio"/> uluslararası
Soru 1.4 Çalışan Sayınız ?	<input type="radio"/> 1< <5 <input checked="" type="radio"/> 5< <20 <input type="radio"/> 20< <100 <input type="radio"/> 100<
Question 1.5 Kurumunuzun sismik risk konusundaki ilgi düzeyi?	<input type="radio"/> Yok <input type="radio"/> Düşük <input checked="" type="radio"/> Orta <input type="radio"/> Yüksek

Photo 3. Example Questionnaire for Stakeholders/End-users

KISIM 1: KURUM/ORGANİZASYONUNUZ HAKKINDA BİLGİ	
Soru 1.1 Kurumunuzun ismi ?	MİLİFER BELEDİYESİ / BÜP SA
Soru 1.2 Kurumunuz nasıl bir organizasyondur ?	<input checked="" type="radio"/> kamu kurumu (kent, bölge, ulusal düzey) <input type="radio"/> sivil savunma kurumu <input type="radio"/> Kritik yapılar ve altyapılar konusunda yönetici <input type="radio"/> sivil toplum örgütü (NGO) <input type="radio"/> Özel Mühendislik Firması/Şirketi <input type="radio"/> Tasarım Firması <input type="radio"/> Geoteknik Danışmanlık Firması <input type="radio"/> GIS konusunda firma <input type="radio"/> Genel Mütehit <input type="radio"/> Özel Geteknik Müşavir <input type="radio"/> Sigorta Şirketi <input type="radio"/> concessionaire company <input type="radio"/> Araştırma Şirketi <input type="radio"/> Diğer ise lütfen belirtiniz:
Soru 1.3 Organizasyonunuz hangi coğrafi düzeyde çalışıyor?	<input checked="" type="radio"/> Yerel (kent, bölgesel) <input type="radio"/> Ulusal <input type="radio"/> uluslararası
Soru 1.4 Çalışan Sayınız ?	<input type="radio"/> 1< <5 <input type="radio"/> 5< <20 <input type="radio"/> 20< <100 <input checked="" type="radio"/> 100<
Question 1.5 Kurumunuzun sismik risk konusundaki ilgi düzeyi?	<input type="radio"/> Yok <input type="radio"/> Düşük <input checked="" type="radio"/> Orta <input type="radio"/> Yüksek



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Photo 4. Example Questionnaire for Stakeholders/End-users

KISIM 1: KURUM/ORGANİZASYONUNUZ HAKKINDA BİLGİ	
Soru 1.1 Kurumunuzun ismi ?	İMMOB İnşaat Mühendisleri Odası steronl Sahesi
Soru 1.2 Kurumunuz nasıl bir organizasyondur ?	<input checked="" type="radio"/> kamu kurumu (kent, bölge, ulusal düzey) <input type="radio"/> sivil savunma kurumu <input type="radio"/> Kritik yapılar ve altyapılar konusunda yönetici <input checked="" type="radio"/> sivil toplum örgütü (NGO) <input type="radio"/> Özel Mühendislik Firması/şirketi <input type="radio"/> Tasarım Firması <input type="radio"/> Geoteknik Danışmanlık Firması <input type="radio"/> GIS konusunda firma <input type="radio"/> Genel Mühelit <input type="radio"/> Özel Geoteknik Müşavir <input type="radio"/> Sigorta Şirketi <input type="radio"/> concessionaire company <input type="radio"/> Araştırma Şirketi <input type="radio"/> Diğer ise lütfen belirtiniz:
Soru 1.3 Organizasyonunuz hangi coğrafi düzeyde çalışıyor?	<input checked="" type="radio"/> Yerel (kent, bölgesel) <input type="radio"/> Ulusal <input type="radio"/> uluslararası
Soru 1.4 Çalışan Sayınız ?	<input type="radio"/> 1< <5 <input type="radio"/> 5< <20 <input type="radio"/> 20< <100 <input checked="" type="radio"/> 100<
Question 1.5 Kurumunuzun sismik risk konusundaki ilgi düzeyi?	<input type="radio"/> Yok <input type="radio"/> Düşük <input type="radio"/> Orta <input checked="" type="radio"/> Yüksek

Photo 5. Example Questionnaire for Stakeholders/End-users

KISIM 1: KURUM/ORGANİZASYONUNUZ HAKKINDA BİLGİ	
Soru 1.1 Kurumunuzun ismi ?	GEOTEK İNŞAAT A.Ş.
Soru 1.2 Kurumunuz nasıl bir organizasyondur ?	<input type="radio"/> kamu kurumu (kent, bölge, ulusal düzey) <input type="radio"/> sivil savunma kurumu <input type="radio"/> Kritik yapılar ve altyapılar konusunda yönetici <input type="radio"/> sivil toplum örgütü (NGO) <input type="radio"/> Özel Mühendislik Firması/şirketi <input type="radio"/> Tasarım Firması <input type="radio"/> Geoteknik Danışmanlık Firması <input type="radio"/> GIS konusunda firma <input type="radio"/> Genel Mühelit <input checked="" type="radio"/> Özel Geoteknik Müşavir <input type="radio"/> Sigorta Şirketi <input type="radio"/> concessionaire company <input type="radio"/> Araştırma Şirketi <input type="radio"/> Diğer ise lütfen belirtiniz:
Soru 1.3 Organizasyonunuz hangi coğrafi düzeyde çalışıyor?	<input type="radio"/> Yerel (kent, bölgesel) <input checked="" type="radio"/> Ulusal <input checked="" type="radio"/> uluslararası
Soru 1.4 Çalışan Sayınız ?	<input checked="" type="radio"/> 1< <5 <input type="radio"/> 5< <20 <input type="radio"/> 20< <100 <input type="radio"/> 100<
Question 1.5 Kurumunuzun sismik risk konusundaki ilgi düzeyi?	<input type="radio"/> Yok <input checked="" type="radio"/> Düşük <input checked="" type="radio"/> Orta <input type="radio"/> Yüksek