## Deliverable

### D1.5. Implementation of SERA services in EPOS operational phase

<table>
<thead>
<tr>
<th>Work package</th>
<th>WP1 (ETH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deliverable lead</td>
<td>INGV</td>
</tr>
<tr>
<td>Authors</td>
<td>Lilli Freda (INGV), Massimo Cocco (INGV), Domenico Giardini (ETH), Kauzar Saleh (ETH), Kuvvet Atakan (UiB), Jan Michalek (UiB)</td>
</tr>
<tr>
<td>Reviewers</td>
<td>-</td>
</tr>
<tr>
<td>Approval</td>
<td>-</td>
</tr>
<tr>
<td>Status</td>
<td>Final</td>
</tr>
<tr>
<td>Dissemination level</td>
<td>Public</td>
</tr>
<tr>
<td>Delivery deadline</td>
<td>30.04.2020</td>
</tr>
<tr>
<td>Submission date</td>
<td>30.04.2020</td>
</tr>
<tr>
<td>Intranet path</td>
<td>DOCUMENTS/DELIVERABLES/SERA_D1.5_Implementation_SERA_services_EPOS.pdf</td>
</tr>
</tbody>
</table>
# Table of Contents

Summary.................................................................................................................................................. 3
1  EPOS: Current status of implementation.................................................................................................. 3
2  Relationship between SERA & EPOS ........................................................................................................ 5
3  Advancements achieved in SERA for the future operation of services through EPOS....................... 8
Contact....................................................................................................................................................... 15
Summary

This deliverable is an update of the deliverable submitted at M18, taking into account the results of the SERA project and the status of development of the EPOS-ERIC research infrastructure. EPOS-ERIC is a recognised organisation since October 2018, and is currently in this pre-operational phase. Nominal operations are expected to start in 2022. In SERA, a number of WPs have generated advancements in the readiness of seismology and earthquake engineering services to be proposed as EPOS services (primarily in the area of earthquake engineering, deep seismic sounding data, hazard and risk products), or to test their robustness in the case of already running Virtual Access services (seismological data and products, anthropogenic hazards, etc.). This deliverable presents the current status of those services, and will be used by the SERA community and EPOS-ERIC to define the next steps required for their integration in the EPOS catalogue, where the activation of services depends on service maturity (technical, legal, governance, financial) and it is subject to the decisions of the EPOS-ERIC governing bodies.

1 EPOS: Current status of implementation

EPOS ([https://www.epos-ip.org](https://www.epos-ip.org)) is a research infrastructure aimed at creating a Pan-European infrastructure for solid Earth science to support society. The EPOS scientific mission is to integrate the diverse and advanced European research infrastructure for solid Earth Science relying on new e-science opportunities to monitor and unravel the dynamic and complex Earth System. EPOS ultimate goal is to enable innovative multidisciplinary research for a better understanding of the Earth’s physical processes that control earthquakes, volcanic eruptions, ground instability, tsunami, and tectonics. This goal will be achieved by implementing thematic services and by ensuring integration within the full EPOS framework, covering legal, governance and financial aspects, and interoperability through the novel e-science solution.

The **Integrated Core Services (ICS, Figure 1)** has been designed and implemented to deliver tools to facilitate the discovery of data, data products, software and services and the integration of these resources to fulfil users requests. The key element of the ICS in EPOS will be a central hub (ICS-C), the EPOS web portal, where users can discover and access to services available in the Thematic Core Services and National Research Infrastructures. The ICS-C system design is based on the usage of a metadata catalogue, which maps and describes all the “assets” available from the EPOS community. The ICS-C system itself uses leading edge technologies and it is based on a micro-services approach, which makes the system scalable and the integration of new resources and services easy and fast. In particular, the ICS-C metadata catalogue utilises CERIF (Common European Research Information Format, a EU Recommendation to Member States) as its rich metadata format.

The **Thematic Core Services (TCS, Figure 1)** represent the community-specific framework in which to implement and operate the data and service provision offered by each community to users through EPOS. They act as transnational governance frameworks where data and services are provided to answer scientific questions and where each community discusses their specific implementation, best practices and sustainability strategies as well as legal and ethical issues. All TCS have been working for the last years to design their own legal and governance structure, adapted to their services and specific needs and constraints. In particular, each TCS has established a legal and governance structure represented by a Consortium Agreement to ensure the engagement of the communities and national
teams. Users and Data Providers will be engaged in the TCS Governance. Within each TCS, the identified Service Providers will sign Service Contracts with EPOS-ERIC, in order to guarantee the data and service provision. The envisaged financial framework for the delivery of EPOS-ERIC services is part of the EPOS Financial Plan. A list of potential TCS services, for which standards in terms of eligibility of types of services and costs were previously defined in a cost model applicable to all TCS, have been compiled and reported in the EPOS Cost-Book (Table 2 of this deliverable).

Figure 1. EPOS architecture and links to SERA activities.

EPOS-ERIC is now a legal body with seat in Italy, whose governance falls under the General Assembly, with 13 countries involved as full members or observers. The EPOS infrastructure is currently in the Pilot Operational Phase (2020-2022), a period necessary to test access to services, and to complete all the procedures for the decision-making capacity of the organisation. During 2020, it is foreseen to start funding activities linked to the governance of the TCS, and as of 2021 some data services. During the H2020 EPOS-IP (EPOS Implementation Phase) project, the organisations in charge of delivering data/services/products/software to EPOS were identified, and the formalisation of service delivery is currently being developed. To that extent, the H2020 EPOS-SP (Sustainability Phase) will strengthen key pillars for the long-term sustainability of EPOS, such as data access, data use, financial sustainability, and links to the private sector, to name a few. Finally, during the Pilot Operational Phase, the EPOS General Assembly will decide on the mechanisms to activate specific services from the EPOS catalogue of services, relying on scientific, technical, legal, governance, and financial criteria. In that respect, SERA has helped to further validate services from the EPOS catalogue of potential services, to develop new ones, and to network research communities with data and products that could enlarge the EPOS catalogue in the future.
2 Relationship between SERA & EPOS

The EPOS platform will provide visualization and discovery of data, data products, software and services across all main solid Earth science disciplines. This is possible thanks to the development of thematic services through time, funded through a variety of national and EC projects as well as national funds. In the last few years, the FP7 EPOS Preparatory Phase project (EPOS PP) and H2020 EPOS Implementation Phase project (EPOS IP), have focused on the development and implementation - according to the technical, legal, and governance requirements of EPOS - of TCS services across ten disciplines (see Section 3). In the future, EPOS will only provide partial financial support to the TCS, which will continue to rely on national support and competitive funding for developing new services and for supporting EPOS operations.

Figure 2 shows an overview of past and existing EC projects (from 2006 onwards), which illustrates the role of the different EC projects in supporting the consolidation of an advanced research community. Through the various projects in Figure 2, it has been possible to advance in the understanding of specific scientific questions through Joint Research Activities, that have led (and will lead) to developing new components of services. Once coordinated with the support of Networking Activities, these components become individual operational services accessible to the community (Virtual Access). In this process, the strategy has also been to bring individual research groups into integrated advanced research communities, and to foster the exchange across related disciplines with the purpose of developing joint services (e.g. seismology and engineering communities). Some specific examples of this strategy are:

- The FP7-SERIES project (Seismic Engineering Research Infrastructures For European Synergies) conducted experimental research in earthquake engineering; the SERIES databases are now being updated in SERA through a Networking Activity involving the main earthquake engineering experimental facilities in Europe, so that access to earthquake engineering experimental data is archived and accessible. As a result, a new Virtual Access service provision for EPOS will be available at the end of SERA, that incorporates also the facilities and datasets generated by Transnational Access in SERA.

- The FP7-SHARE project (Seismic Hazard Harmonization in Europe) produced in 2013 the first seismic hazard model for the Euro-Mediterranean region (ESHM13); this model is now being updated in SERA (Joint Research Activities), and will lead to a new model of the European seismic hazard (ESHM20) on time for the revision of the European seismic norms (Eurocode 8), where it will be applied. At the same time, another Joint Research Activity in SERA will expand the exposure and vulnerability results of FP7-NERA (Network of European Research Infrastructures for Earthquake Risk Assessment and Mitigation) and FP7-SYNER-G (Systemic Seismic Vulnerability and Risk Analysis for Buildings, Lifeline Networks and Infrastructures Safety Gain), to develop a risk modeling framework for Europe. Then, EFEHR (European Facilities for Earthquake Hazard and Risk) will provide additional services through its earthquake hazard...
and risk tools and products platform (Virtual Access in SERA), and once validated, will deliver operational services in EPOS.

The specific areas where EPOS and SERA are linked are shown in Figure 1. More detailed objectives of the EPOS and SERA interaction strategy are to:

- Provide an important contribution to the construction and validation of EPOS, by developing major building blocks for the provision of key services in seismology, anthropogenic hazards and earthquake engineering.
- Validate in the pre-operation phase the most important pillars of virtual access to data and products from seismology and anthropogenic seismicity.
- Develop new service pillars in domains planned but not yet developed in EPOS, including active seismology data and products, site characterization and earthquake engineering experimental data.
- Offer the first large-scale transnational access to a coherent set of large research infrastructures, enabling to test one of the planned service modes of EPOS.
- Promote co-ordination and pooling of resources benefitting the EPOS operational phase.
In order to fulfil this strategy, the design of SERA incorporated the following specific measures:

- SERA is anchored in the structure of three EPOS TCS - Seismology, Near-Fault Observatories and Anthropogenic Hazards; in addition, SERA incorporates the TCS-ICS interoperability activities covered by WP6 in EPOS-IP (in charge of partner UiB in both EPOS and SERA), to ensure that the services developed or validated in SERA will be compatible for integration in the EPOS operational phase.

- The SERA TA and VA services offer access which will be included in the EPOS Operational Phase at the end of the EPOS IP implementation and once the ERIC is in force; these services are planned by EPOS but are not yet offered in EPOS IP; SERA will enable validating their operational level, costs and the return by the user and stakeholder community.

- The SERA NA and JRA develop the networking, knowledge and products, which will serve to improve the offered services and to build a further generation of service pillars for EPOS.
• Key EPOS people have important roles in SERA: the EPOS-IP leaders of TCS Seismology, TCS Near-Fault Observatories and TCS Anthropogenic Hazards are all involved in the SERA activities; the SERA Coordinator was head of strategy in EPOS-PP, leads the Financial Framework in EPOS-IP and is member of the EPOS-IP Project Development Board (PDB); the SERA Manager is working on the EPOS-IP Financial Framework and is member of the EPOS-IP PDB; the leader of the TCS-ICS integration in EPOS participates in SERA NA and JRA WPs to ensure interoperability with the EPOS ICS architecture; the EPOS Secretariat is represented in SERA WP1, with EPOS-IP Director being member of the SERA Management Board, and EPOS-IP Coordinator and EPOS Interim Director authoring this deliverable.
• SERA will report regularly to EPOS on progress of services, which will be later included in the EPOS operational phase.
• The SERA timeline has been aligned with the EPOS construction.

3 Advancements achieved in SERA for the future operation of services through EPOS

This section provides details on the specific contributions of SERA to EPOS, as well as the current status of implementation in EPOS at M36 (Table 1). A description of items referred to in Table 1 is given next:

• TCS in EPOS: These are the ten Thematic Core Services (TCS) in EPOS:
  - **TCS SEIS (WP8 Seismology)**
  - **TCS GNSS (WP10 GNSS Data and Products)**
  - **TCS SATD (WP12 Satellite Data)**
  - **TCS AHAZ (WP14 Anthropogenic Hazards)**
  - **TCS LABS (WP16 Multi-scale Laboratories)**
  - **TCS NFOS (WP9 Near-Fault Observatories)**
  - **TCS VOLC (WP11 Volcano Observations)**
  - **TCS GEOM (WP13 Geomagnetic Observations)**
  - **TCS GEOL (WP15 Geological Information and Modelling)**
  - **TCS GETB (WP17 Geo-energy testbeds for low carbon energy)** – also connected to SERA through JRA1/JRA2.

• **List of WPs in SERA:**
  - WP1 Management (ETH)
  - WP2 Communication (ETH)
  - WP3 NA1: Networking Seismo@school outreach programs (UKRI)
  - WP4 NA2: Expanding access to the European seismic monitoring infrastructure (KNMI)
  - WP5 NA3: Networking Deep Seismic Sounding data and products (UU)
  - WP6 NA4: Networking experimental seismic engineering databases (SERIES) (JRC)
• **EPOS Cost-book services:** EPOS IP has produced a catalogue of potential EPOS services, with associated costs, contained in the so-called EPOS Cost-book. In this context, an EPOS service has to be understood as an element with a key purpose (for example the TCS Governance), or as a group of theme-related data or products (for example, earthquake parameter information provided by EMSC). Each service in the cost-book follows this nomenclature: WPNr-SP-ServiceNumber.

The EPOS services listed in Table 1 can be identified in the Cost-book services of Table 2. A distinction is made between **core services** (a label used to designate services mature enough to be activated in the short term) and **future services** (as further development is still needed).

• **Role of SERA:** The types of SERA roles described in Table 1 correspond to either:

  o **Product development:** this means SERA contributes to develop new products and to make them interoperable with EPOS, before they can enter the EPOS catalogue of services ready for operations. E.g. new seismic risk products.

  o **Service development:** this means SERA contributes to develop new services (some aggregating various datasets/products), before they enter the EPOS catalogue of services ready for operations. E.g. new virtual access service to earthquake engineering databases.

  o **EU validation:** this means SERA serves to validate services (through the acceptance of project deliverables by the EC, assessment of costs, etc.), so they can be offered to enter the EPOS catalogue of operational services. E.g. Virtual access to seismic hazard products.

  o **Service Provision:** this means SERA supports during its lifetime services of the EPOS catalogue of services, whether in the area of Governance, Coordination, Outreach,
Transnational Access or Data-related services. E.g. Transnational Access to earthquake engineering infrastructures.

- **Governance/Web service status:** The following categories are given in Table 1 as an indication of status:

  **For Governance:**
  
  - **Validated in EPOS-IP:** this is an indicator that the validation process conducted in EPOS-IP (2015-2019) was successful at TCS level.
  - **TCS Consortium agreement in place:** this means that the TCS has already a signed document regulating the governance structure of the TCS, represented by a consortium board of service providers.

  **For Web services:**
  
  - **Implemented at ICS level:** this is an indication that access to data/data products/services/software through the EPOS ICS has been tested, and it is compliant with all the technical and licensing requirements of the EPOS ICS.
  - **Implemented at TCS level:** this means that data/data products/services/software is already available as a web service, however through distribution mechanisms other than the ICS. In that case, either additional work is required to visualise data through the ICS, or the web service still has to be tested by the ICS.
  - **Roadmap for proposal to EPOS:** this means that the community behind a particular web service has started network activities, with a view to be included in the EPOS catalogue of future services.
<table>
<thead>
<tr>
<th>WP</th>
<th>TITLE</th>
<th>ROLE</th>
<th>TCS</th>
<th>SERVICE TITLE</th>
<th>COST-BOOK CODE</th>
<th>EPOS-IP CATALOGUE</th>
<th>GOVERNANCE/WEB SERVICES STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA1</td>
<td>Networking European Seismo@School programs</td>
<td>Networking</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Not included</td>
<td></td>
</tr>
<tr>
<td>NA2</td>
<td>Expanding access to European seismic network</td>
<td>NA + service development</td>
<td>SEIS</td>
<td>Governance and outreach for ORFEUS</td>
<td>WP08-SP-002</td>
<td>Core service</td>
<td>VALIDATED IN EPOS-IP, TCS CONSORTIUM AGREEMENT IMPLEMENTED IN EPOS ICS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>EIDA node operations</td>
<td>WP08-SP-005 to -013</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>Future services on OBS, mobile pools</td>
<td>WP08-SP-034-035</td>
<td>Future service</td>
<td>IMPLEMENTED AT TCS LEVEL <a href="https://www.orfeus-eu.org/data">https://www.orfeus-eu.org/data</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>ODC products and services</td>
<td>WP08-SP-014</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td>NA3</td>
<td>Networking deep seismic sounding data/products</td>
<td>NA + service development</td>
<td>SEIS</td>
<td>-</td>
<td>-</td>
<td>Not included</td>
<td>Roadmap outlined in SERA D5.3, D5.4 for proposal to EPOS as new service in TCS SEIS</td>
</tr>
<tr>
<td>NA4</td>
<td>Networking experimental seismic engineering dbs</td>
<td>NA + service development</td>
<td>SEIS</td>
<td>Access to earthquake engineering databases</td>
<td>WP08-SP-038</td>
<td>Future service</td>
<td>IMPLEMENTED AT TCS LEVEL (TCS EARTHQUAKE ENGINEERING), TESTED IN ICS</td>
</tr>
<tr>
<td>NA5</td>
<td>Networking dbs of site and station characterisation</td>
<td>NA + service development</td>
<td>SEIS</td>
<td>Site characterisation and archive</td>
<td>WP08-SP-026</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>European Geotechnical db</td>
<td>WP08-SP-030</td>
<td>Future Service</td>
<td>IMPLEMENTED AT TCS LEVEL <a href="http://egd-epos.civil.auth.gr/">http://egd-epos.civil.auth.gr/</a></td>
</tr>
<tr>
<td>VA1</td>
<td>Virtual access to seismological products at EMSC</td>
<td>Service validation</td>
<td>SEIS</td>
<td>Governance and outreach for EMSC</td>
<td>WP08-SP-021</td>
<td>Core service</td>
<td>VALIDATED IN EPOS-IP, TCS CONSORTIUM AGREEMENT IMPLEMENTED IN EPOS ICS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>EMSC earthquake parameter information</td>
<td>WP08-SP-022</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>EMSC seismological product platform</td>
<td>WP08-SP-023</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td>VA2</td>
<td>Virtual access to seismic waveforms at ORFEUS/KNMI</td>
<td>Service validation</td>
<td>SEIS</td>
<td>EIDA node operations</td>
<td>WP08-SP-005 to -013</td>
<td>Core service</td>
<td>IMPLEMENTED IN EPOS ICS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>ODC products and services</td>
<td>WP08-SP-014</td>
<td>Core service</td>
<td>IMPLEMENTED AT TCS LEVEL <a href="https://www.orfeus-eu.org/data">https://www.orfeus-eu.org/data</a></td>
</tr>
<tr>
<td>VA3</td>
<td>Virtual access to engineering seismology services at INGV</td>
<td>Service validation</td>
<td>SEIS</td>
<td>European strong motion data and products</td>
<td>WP08-SP-015</td>
<td>Core service</td>
<td>IMPLEMENTED IN EPOS ICS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>AHEAD historical earthquake data</td>
<td>WP08-SP-024</td>
<td>Core service</td>
<td>IMPLEMENTED IN EPOS ICS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>European database of seismogenic faults</td>
<td>WP08-SP-029</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td>VA4</td>
<td>Virtual access to hazard and risk products at EFEHR</td>
<td>Service validation</td>
<td>SEIS</td>
<td>EFEHR platform operation</td>
<td>WP08-SP-027</td>
<td>Core service</td>
<td>IMPLEMENTED IN EPOS ICS (products); IMPLEMENTED AT TCS LEVEL <a href="http://www.efehr.org">http://www.efehr.org</a></td>
</tr>
<tr>
<td>VA5</td>
<td>Virtual access to data and products at iGPAS</td>
<td>Service validation</td>
<td>AHAZ</td>
<td>Virtual access to IS-platform</td>
<td>WP14-SP-006</td>
<td>Core service</td>
<td>IMPLEMENTED IN EPOS ICS (partially)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AHAZ</td>
<td>Virtual access to EOST eNode</td>
<td>WP14-SP-007</td>
<td>Core service</td>
<td>IMPLEMENTED AT TCS LEVEL <a href="https://www.orfeus-eu.org/data">https://www.orfeus-eu.org/data</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AHAZ</td>
<td>Virtual access to iGPAS eNode</td>
<td>WP14-SP-008</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td>JRA1</td>
<td>Physics of earthquake initiation</td>
<td>Research</td>
<td></td>
<td></td>
<td></td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>JRA2</td>
<td>Activity rates of induced and natural earthquakes</td>
<td>Research</td>
<td></td>
<td></td>
<td></td>
<td>Not applicable</td>
<td></td>
</tr>
<tr>
<td>JRA3</td>
<td>Updating/ extending the EU Seismic Hazard Model</td>
<td>Research</td>
<td>SEIS</td>
<td>EFEHR platform operation</td>
<td>WP08-SP-027</td>
<td>Core service</td>
<td>IMPLEMENTED IN ICS (products); IMPLEMENTED AT TCS LEVEL <a href="http://www.efehr.org">http://www.efehr.org</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>Governance and outreach for EFEHR</td>
<td>WP08-SP-026</td>
<td>Core service</td>
<td>VALIDATED BY EPOS-IP, TCS CONSORTIUM AGREEMENT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>European GMPE</td>
<td>WP08-SP-028</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td>JRA4</td>
<td>Risk modelling framework for Europe</td>
<td>Research</td>
<td>SEIS</td>
<td>Virtual access to risk assessment codes</td>
<td>WP08-SP-037</td>
<td>Future service</td>
<td></td>
</tr>
<tr>
<td>JRA5</td>
<td>Testing methods for component/system resilience</td>
<td>Research</td>
<td>SEIS</td>
<td>European strong motion data in buildings</td>
<td>WP08-SP-031</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>European GMPE</td>
<td>WP08-SP-028</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td>JRA6</td>
<td>Real-time earthquake shaking</td>
<td>Research</td>
<td>SEIS</td>
<td>European strong motion data in buildings</td>
<td>WP08-SP-031</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEIS</td>
<td>European GMPE</td>
<td>WP08-SP-028</td>
<td>Core service</td>
<td></td>
</tr>
<tr>
<td>TA1-8</td>
<td>TA to earthquake engineering RI</td>
<td>Transnational Access</td>
<td>SEIS</td>
<td>TA to earthquake engineering infrastructures</td>
<td>WP08-SP-032, -039</td>
<td>Future service</td>
<td></td>
</tr>
<tr>
<td>TA9-10</td>
<td>TA to earthquake seismology RI</td>
<td>Transnational Access</td>
<td>SEIS</td>
<td>TA to seismology infrastructures</td>
<td>WP08-SP-040, -041</td>
<td>Future service</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Mapping of SERA services, EPOS services, and governance/web service status.
<table>
<thead>
<tr>
<th>ID</th>
<th>SERVICE NAME</th>
<th>SERVICE DESCRIPTION</th>
<th>SP</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOV</td>
<td>WP08-SP-001</td>
<td>TCS Governance, Coord., Outreach</td>
<td>TCS Seismology Consortium Secretariat / Chair</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>SUBTOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOV</td>
<td>WP08-SP-002</td>
<td>Governance &amp; Outreach</td>
<td>Governance and outreach activities for ORFEUS</td>
<td>ORFEUS</td>
</tr>
<tr>
<td>GOV</td>
<td>WP08-SP-003</td>
<td>Coordination</td>
<td>Computational waveform services coordination</td>
<td>KIT</td>
</tr>
<tr>
<td>GOV</td>
<td>WP08-SP-004</td>
<td>Outreach &amp; Training</td>
<td>Computational waveform services outreach &amp; training</td>
<td>INGV</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-005</td>
<td>EIDA waveform access</td>
<td>EIDA node operations and service maintenance</td>
<td>KNMI/ ORFEUS</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-006</td>
<td>EIDA waveform access</td>
<td>EIDA node operations and service maintenance</td>
<td>GFZ</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-007</td>
<td>EIDA waveform access</td>
<td>EIDA node operations</td>
<td>INGV</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-008</td>
<td>EIDA waveform access</td>
<td>EIDA node operations</td>
<td>CNRS-RESIF</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-009</td>
<td>EIDA waveform access</td>
<td>EIDA node operations</td>
<td>ETH</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-010</td>
<td>EIDA waveform access</td>
<td>EIDA node operations</td>
<td>NOA</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-011</td>
<td>EIDA waveform access</td>
<td>EIDA node operations</td>
<td>BOUN</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-012</td>
<td>EIDA waveform access</td>
<td>EIDA node operations</td>
<td>BGR</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-013</td>
<td>EIDA waveform access</td>
<td>EIDA node operations</td>
<td>INF</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-014</td>
<td>ODC products and services</td>
<td>RRTSM data products, station info., USGS shakemap input</td>
<td>KNMI/ ORFEUS</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-015</td>
<td>European Strong Motion D&amp;P</td>
<td>Data processing/revision; event access; USGS shakemap inputs</td>
<td>INGV</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-016</td>
<td>Waveform modelling portal</td>
<td>Portal maintenance / user support</td>
<td>KIT</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-017</td>
<td>Waveform modelling portal</td>
<td>Portal maintenance / user support</td>
<td>INGV</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-018</td>
<td>Waveform modelling portal</td>
<td>Portal maintenance / user support</td>
<td>KNMI</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-019</td>
<td>Waveform modelling portal</td>
<td>SPECFEM (3D/global) operat. and user support</td>
<td>CNRS- LMA</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-020</td>
<td>Waveform modelling portal</td>
<td>AXISEM operational and user support</td>
<td>U. OXFORD</td>
</tr>
<tr>
<td><strong>SUBTOTAL</strong></td>
<td></td>
<td>Seismological Products Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOV</td>
<td>WP08-SP-021</td>
<td>Governance &amp; Outreach</td>
<td>Seismological products Governance and Outreach</td>
<td>EMSC</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-022</td>
<td>EMSC Earthquake parameter info.</td>
<td>EMSC Earthquake parameter information</td>
<td>EMSC</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-023</td>
<td>EMSC Seismological Product Platform</td>
<td>EMSC Seismological Product Platform</td>
<td>EMSC</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-024</td>
<td>AHEAD historical earthquake data</td>
<td>AHEAD historical earthquake data</td>
<td>INGV</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-025</td>
<td>Site characterization and archive</td>
<td>Site characterization and archive</td>
<td>CNRS- ISTERRE</td>
</tr>
<tr>
<td><strong>SUBTOTAL</strong></td>
<td></td>
<td>Earthquake Facilities for Seismic Hazard and Risk Services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GOV</td>
<td>WP08-SP-026</td>
<td>Governance &amp; Outreach</td>
<td>EFEHR Governance and Outreach</td>
<td>ETH</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-027</td>
<td>EFEHR platform</td>
<td>EFEHR Platform operation</td>
<td>ETH</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-028</td>
<td>GMPE service</td>
<td>European Ground Motion Prediction Equation</td>
<td>GFZ</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-029</td>
<td>EDSF service</td>
<td>European Database of Seismogenic Faults</td>
<td>INGV</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP08-SP-031</td>
<td>ESMB service</td>
<td>European Strong Motion data in buildings service</td>
<td>BOUN</td>
</tr>
</tbody>
</table>

Table 2a. Cost-book sheet from EPOS-IP for TCS Seismology (proposed services for operations)
### Table 2b. Cost-book sheet from EPOS-IP for TCS Seismology (TA, and services for future implementation)

<table>
<thead>
<tr>
<th>ID</th>
<th>SERVICE NAME</th>
<th>SERVICE DESCRIPTION</th>
<th>SP</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transnational access</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TA</td>
<td>WP08-SP-040 Coordination of TA to Seismology RIs</td>
<td>Governance and coordination</td>
<td>TBO</td>
<td>TBO</td>
</tr>
<tr>
<td>TA</td>
<td>WP08-SP-033 TA support to Seismology RIs</td>
<td>Host institution and visiting scientist support</td>
<td>Open call</td>
<td></td>
</tr>
<tr>
<td>TA</td>
<td>WP08-SP-039 Coordination of TA to Earthq. Eng. RIs</td>
<td>Governance and coordination</td>
<td>TBO</td>
<td>TBO</td>
</tr>
<tr>
<td>TA</td>
<td>WP08-SP-032 TA support to Earthquake Eng. RIs</td>
<td>Host institution and visiting scientist support</td>
<td>Open call</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL DIRECT COSTS**

<table>
<thead>
<tr>
<th>SERVICE NAME</th>
<th>SERVICE DESCRIPTION</th>
<th>SP</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Future services in preparation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SERVICE WP08-SP-034 Mobile Pools &amp; temporary deployment</td>
<td>Mobile Pools &amp; temporary deployment</td>
<td>CSIC</td>
<td>ES</td>
</tr>
<tr>
<td>SERVICE WP08-SP-035 Ocean Bottom Seismometry D&amp;P</td>
<td>Ocean Bottom Seismometry D&amp;P</td>
<td>CNRS-IPGP</td>
<td>FR</td>
</tr>
<tr>
<td>SERVICE WP08-SP-036 Operational contact for EGI</td>
<td>Operational contact for EGI</td>
<td>SCAI</td>
<td>DE</td>
</tr>
</tbody>
</table>

### Earthquake Facilities for Seismic Hazard and Risk Services

<table>
<thead>
<tr>
<th>SERVICE NAME</th>
<th>SERVICE DESCRIPTION</th>
<th>SP</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SERVICE WP08-SP-030 EGD service</td>
<td>European Geotechnical Database</td>
<td>AUTH</td>
<td>GR</td>
</tr>
<tr>
<td>SERVICE WP08-SP-037 Risk Assessment service</td>
<td>Access to vulnerability inventories and risk assessment codes</td>
<td>EUCENTRE</td>
<td>IT</td>
</tr>
<tr>
<td>SERVICE WP08-SP-038 EETF service</td>
<td>Access to experimental data from Earthquake Engineering Testing Facilities</td>
<td>JRC</td>
<td>EU</td>
</tr>
</tbody>
</table>
Table 2c. Cost-book sheet from EPOS-IP for TCS Anthropogenic Hazards

<table>
<thead>
<tr>
<th>ID</th>
<th>SERVICE NAME</th>
<th>SERVICE DESCRIPTION</th>
<th>SP</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOV</td>
<td>WP14-SP-001 TCS Governance &amp; Coordination</td>
<td>Coordination, Administration nd TCS Council (including innovation Advisory Committee)</td>
<td>IG-PAS</td>
<td>PL</td>
</tr>
<tr>
<td>GOV</td>
<td>WP14-SP-002 TCS Governance &amp; Coordination</td>
<td>Section for projects and partnership</td>
<td>LTU</td>
<td>SE</td>
</tr>
<tr>
<td>GOV</td>
<td>WP14-SP-003 TCS promotion and dissemination</td>
<td>Promoting TCS in various environments: governmental, academia, industry, public;</td>
<td>EOST</td>
<td>FR</td>
</tr>
<tr>
<td>GOV</td>
<td>WP14-SP-004 Implementation of TCS services</td>
<td>Section for implementing TCS services</td>
<td>ACK CYFRONET</td>
<td>PL</td>
</tr>
<tr>
<td>GOV</td>
<td>WP14-SP-005 Episode integration and application implementation</td>
<td>Section for episode integration and application implementation</td>
<td>GFZ</td>
<td>DE</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP14-SP-006 IS-EPOS Platform</td>
<td>Virtual access through the IS-Platform to data, products and services (e.g. applications, user’s workspace, visualizations)</td>
<td>IG-PAS/ACK CYFRONET</td>
<td>PL</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP14-SP-007 VAeN1</td>
<td>Virtual access to EOST eNode</td>
<td>EOST</td>
<td>FR</td>
</tr>
<tr>
<td>SERVICE</td>
<td>WP14-SP-008 VAeN2</td>
<td>Virtual access to IG-PAS eNode</td>
<td>IG-PAS</td>
<td>PL</td>
</tr>
</tbody>
</table>
## Contact

<table>
<thead>
<tr>
<th>Role</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project lead</td>
<td>ETH Zürich</td>
</tr>
<tr>
<td>Project coordinator</td>
<td>Prof. Dr. Domenico Giardini</td>
</tr>
<tr>
<td>Project manager</td>
<td>Dr. Kauzar Saleh</td>
</tr>
<tr>
<td>Project office</td>
<td>ETH Department of Earth Sciences&lt;br&gt;Sonneggstrasse 5, NO H62, CH-8092 Zürich&lt;br&gt;<a href="mailto:sera_office@erdw.ethz.ch">sera_office@erdw.ethz.ch</a>&lt;br&gt;+41 44 632 9690</td>
</tr>
<tr>
<td>Project website</td>
<td><a href="http://www.sera-eu.org">www.sera-eu.org</a></td>
</tr>
</tbody>
</table>

### Liability claim

The European Commission is not responsible for any use that may be made of the information contained in this document. Also, responsibility for the information and views expressed in this document lies entirely with the author(s).