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# DELIVERABLE

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

<b>Work package</b>	WP1 (ETH)
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## 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

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EPOS (<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, tsunamis, 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).

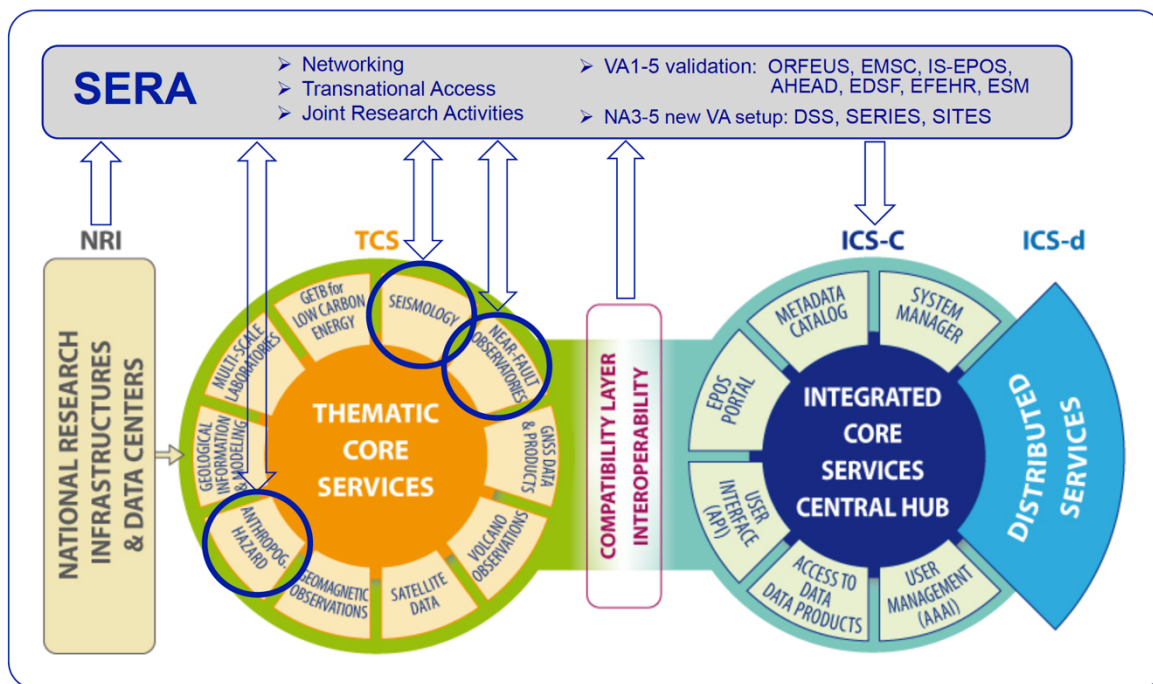


Figure 1. EPOS architecture and links to SERA activities.

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

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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 and 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-operational 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.

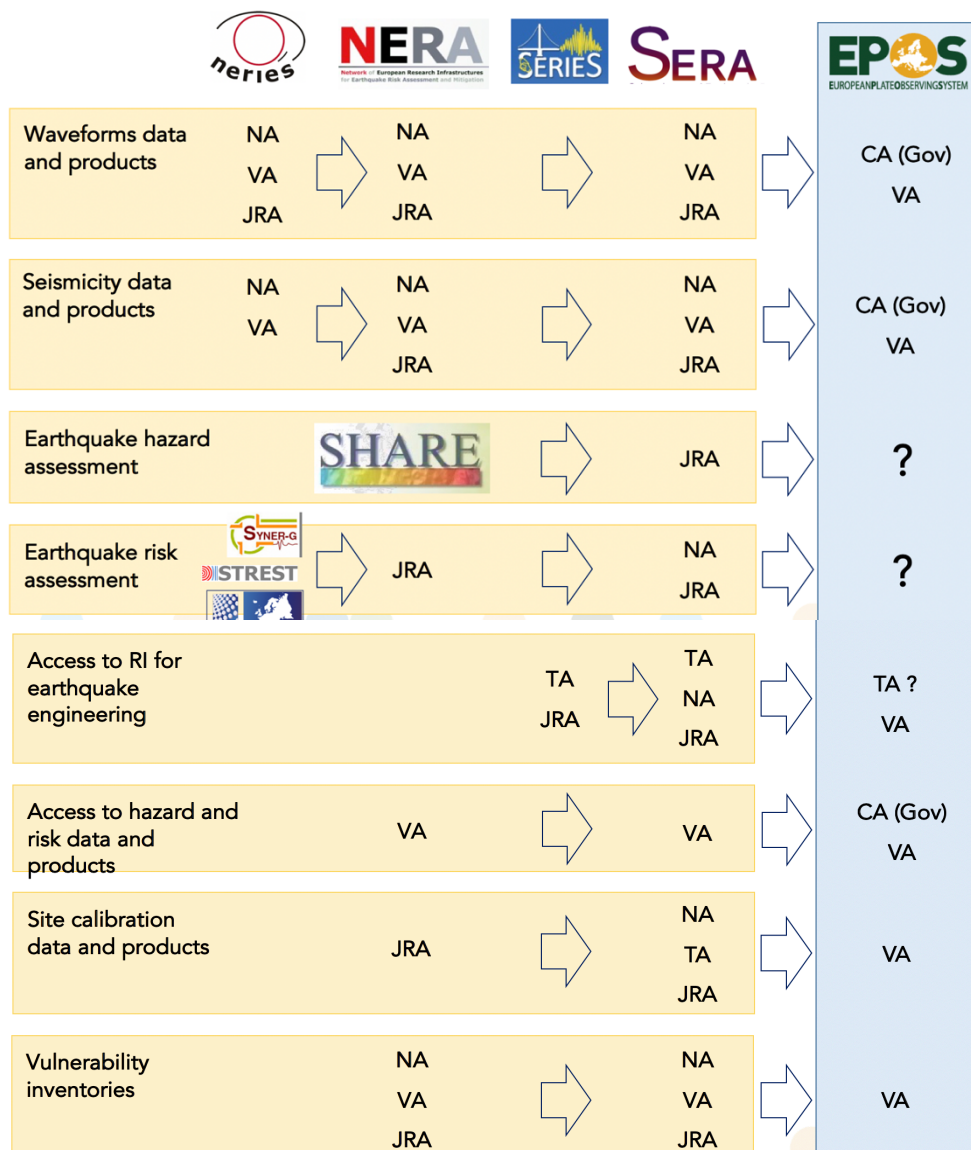


Figure 2. Precursor projects and relationship to SERA and EPOS.

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

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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)



WP7	NA5: Networking databases of site and station characterization (CNRS)
WP8	WP17: Transnational Access to 10 infrastructures
WP18	VA1: Access to seismological products and information at EMSC
WP19	VA2: Access to seismic waveforms at ORFEUS/KNMI
WP20	VA3: Access to data and services for engineering seismology at INGV
WP21	VA4: Access to earthquake hazard and risk products at EFEHR/ETHZ
WP22	VA5: Access to data and products of anthropogenic seismicity at IGPAS
WP23	JRA1: Physics of the earthquake initiation
WP24	JRA2: Characterizing the activity rates of induced and natural earthquakes
WP25	JRA3: Updating and extending the European Seismic Hazard Model
WP26	JRA4: Risk Modelling Framework for Europe
WP27	JRA5: Innovative testing methodologies for component/system resilience
WP28	JRA6: Real-time earthquake shaking

- **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:
  - **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.
  - **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.
  - **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.
  - **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.

SERA (H2020 PROJECT)			EPOS-ERIC (EUROPEAN INFRASTRUCTURE)				GOVERNANCE/WEBSERVICES STATUS
WP	TITLE	ROLE	TCS	SERVICE TITLE	COST-BOOK CODE	EPOS-IP CATALOGUE	
NA1	Networking European Seismo@School programs	Networking	-	-	-	Not included	-
NA2	Expanding access to European seismic network	NA + service development	SEIS	Governance and outreach for ORFEUS	WP08-SP-002	Core service	VALIDATED IN EPOS-IP, TCS CONSORTIUM AGREEMENT
			SEIS	EIDA node operations	WP08-SP-005 to -013	Core service	IMPLEMENTED IN EPOS ICS
			SEIS	Future services on OBS, mobile pools	WP08-SP-034-035	Future service	-
			SEIS	ODC products and services	WP08-SP-014	Core service	IMPLEMENTED AT TCS LEVEL <a href="https://www.orfeus-eu.org/data">https://www.orfeus-eu.org/data</a>
NA3	Networking deep seismic sounding data/products	NA + service development	SEIS	-	-	Not included	Roadmap outlined in SERA D5.3, D5.4 for proposal to EPOS as new service in TCS SEIS
NA4	Networking experimental seismic engineering dbs	NA + service development	SEIS	Access to earthquake engineering databases	WP08-SP-038	Future service	IMPLEMENTED AT TCS LEVEL (TCS EARTHQUAKE ENGINEERING), TESTED IN ICS
NA5	Networking dbs of site and station characterisation	NA + service development	SEIS	Site characterisation and archive	WP08-SP-025	Core service	-
			SEIS	European Geotechnical db	WP08-SP-030	Future Service	IMPLEMENTED AT TCS LEVEL <a href="http://egd-epos.civil.auth.gr/">http://egd-epos.civil.auth.gr/</a>
VA1	Virtual access to seismological products at EMSC	Service validation	SEIS	Governance and outreach for EMSC	WP08-SP-021	Core service	VALIDATED IN EPOS-IP, TCS CONSORTIUM AGREEMENT
			SEIS	EMSC earthquake parameter information	WP08-SP-022	Core service	IMPLEMENTED IN EPOS ICS
			SEIS	EMSC seismological product platform	WP08-SP-023	Core service	IMPLEMENTED AT TCS LEVEL <a href="http://seismicportal.eu">http://seismicportal.eu</a>
VA2	Virtual access to seismic waveforms at ORFEUS/KNMI	Service validation	SEIS	EIDA node operations	WP08-SP-005 to -013	Core service	IMPLEMENTED IN EPOS ICS
			SEIS	ODC products and services	WP08-SP-014	Core service	IMPLEMENTED AT TCS LEVEL <a href="https://www.orfeus-eu.org/data">https://www.orfeus-eu.org/data</a>
VA3	Virtual access to engineering seismology services at INGV	Service validation	SEIS	European strong motion data and products	WP08-SP-015	Core service	IMPLEMENTED IN EPOS ICS
			SEIS	AHEAD historical earthquake data	WP08-SP-024	Core service	IMPLEMENTED IN EPOS ICS
			SEIS	European database of seismogenic faults	WP08-SP-029	Core service	IMPLEMENTED IN EPOS ICS
VA4	Virtual access to hazard and risk products at EFEHR	Service validation	SEIS	EFEHR platform operation	WP08-SP-027	Core service	IMPLEMENTED IN EPOS ICS (products); IMPLEMENTED AT TCS LEVEL <a href="http://www.efehr.org">http://www.efehr.org</a>
VA5	Virtual access to data and products at IGPAS	Service validation	AHAZ	Virtual access to IS-platform	WP14-SP-006	Core service	IMPLEMENTED IN EPOS ICS (partially)
			AHAZ	Virtual access to EOST eNode	WP14-SP-007	Core service	IMPLEMENTED AT TCS LEVEL <a href="https://tcs.ah-epos.eu/">https://tcs.ah-epos.eu/</a>
			AHAZ	Virtual access to IGPAS eNode	WP14-SP-008	Core service	IMPLEMENTED AT TCS LEVEL <a href="https://tcs.ah-epos.eu/">https://tcs.ah-epos.eu/</a>
JRA1	Physics of earthquake initiation	Research				Not applicable	-
JRA2	Activity rates of induced and natural earthquakes	Research				Not applicable	-
JRA3	Updating/extending the EU Seismic Hazard Model	Research	SEIS	EFEHR platform operation	WP08-SP-027	Core service	IMPLEMENTED IN ICS (products); IMPLEMENTED AT TCS LEVEL <a href="http://www.efehr.org">http://www.efehr.org</a>
			SEIS	Governance and outreach for EFEHR	WP08-SP-026	Core service	VALIDATED BY EPOS-IP, TCS CONSORTIUM AGREEMENT
			SEIS	European GMPE	WP08-SP-028	Core service	-
JRA4	Risk modelling framework for Europe	Research	SEIS	Virtual access to risk assessment codes	WP08-SP-037	Future service	-
JRA5	Testing methods for component/system resilience	Research				Not included	Roadmap outlined in SERA D27.3 for proposal to EPOS as new service (Structural Health Monitoring) in TCS SEIS
JRA6	Real-time earthquake shaking	Research	SEIS	European strong motion data in buildings	WP08-SP-031	Core service	-
			SEIS	European GMPE	WP08-SP-028	Core service	-
TA1-8	TA to earthquake engineering RI	Transnational Access	SEIS	TA to earthquake engineering infrastructures	WP08-SP-032, -039	Future service	-
TA9-10	TA to earthquake seismology RI	Transnational Access	SEIS	TA to seismology infrastructures	WP08-SP-040, -041	Future service	-
			GETB	Transnational access to GETB facilities	WP17-SP-007, -008	Future service	-
			GETB	Governance and outreach for GETB	WP17-SP-001, -002	Future service	-
			GETB	Virtual access to GETB datasets	WP17-SP-003-006	Future service	-

Table 1. Mapping of SERA services, EPOS services, and governance/webservice status



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

**Table 2a.** Cost-book sheet from EPOS-IP for TCS Seismology (proposed services for operations)



ID	SERVICE NAME	SERVICE DESCRIPTION	SP	MS	
			<i>Service Provider</i>	<i>Member State</i>	
<b>Transnational access</b>					
TA	WP08-SP-040	Coordination of TA to Seismology RIs	Governance and coordination	TBD	TBD
TA	WP08-SP-033	TA support to Seismology RIs	Host institution and visiting scientist support	Open call	
TA	WP08-SP-039	Coordination of TA to Earthq. Eng. RIs	Governance and coordination	TBD	TBD
TA	WP08-SP-032	TA support to Earthquake Eng. RIs	Host institution and visiting scientist support	Open call	
<b>TOTAL DIRECT COSTS</b>					
<b>FUTURE SERVICES IN PREPARATION</b>					
	SERVICE NAME	SERVICE DESCRIPTION	SP	MS	
			<i>Service Provider</i>	<i>Member State</i>	
<b>Waveform services</b>					
SERVICE	WP08-SP-034	Mobile Pools & temporary deployment	Mobile Pools & temporary deployment	CSIC	ES
SERVICE	WP08-SP-035	Ocean Bottom Seismometry D&P	Ocean Bottom Seismometry D&P	CNRS-IPGP	FR
SERVICE	WP08-SP-036	Operational contact for EGI	Operational contact for EGI	SCAI	DE
<b>Earthquake Facilities for Seismic Hazard and Risk Services</b>					
SERVICE	WP08-SP-030	EGD service	European Geotechnical Database	AUTH	GR
SERVICE	WP08-SP-037	Risk Assessment service	Access to vulnerability inventories and risk assessment codes	EUCENTRE	IT
SERVICE	WP08-SP-038	EETF service	Access to experimental data from EarthquakeEngineering Testing Facilities	JRC	EU

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



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

**Table 2c.** Cost-book sheet from EPOS-IP for TCS Anthropogenic Hazards

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