

EMSO ERIC LONG-TERM VISION AND STRATEGIC PLAN 2018-2020

Observing the Ocean to Save the Earth

EMSO ERIC

European Multidisciplinary Seafloor and water-column Observatory -
European Research Infrastructure Consortium



FORWARD



**Professor Juan José
Dañobeitia**
EMSO ERIC Director
General

It seems like what yesterday was just a dream of a few visionaries, today is a reality and yet we have the ability to observe and study fundamental processes that take place at the seafloor and in the water-column with a brand-new distributed research infrastructure. It has been a long journey and I wish to thank the Members Countries as well as the EMSO scientific community, which have contributed in making it to happen with their constant engagement and enthusiasm.

The ERIC legal status achieved since October 2016, allows us to operate as a consortium with its own autonomy and coordination capacity. We cannot rest however on this milestone: The Regional Facilities are capable to support the full operation of the infrastructure. Furthermore, we recognise the need to mature our vision on the next 3 years, to define a common view on what EMSO wants to achieve and how.

I am honoured to present the Long-term Vision and Strategic Plan EMSO ERIC 2018-2020 which encompasses the ambitions of the Member Countries and the EMSO scientific community.

The sustainability to carry out this ambitious infrastructure is presently ensured by the support of the eight Member Countries and by a series of enabling projects financed by the EC, and in the long term by the services provided. This will allow us to serve society, researchers, technologists, policymakers, industry and stakeholders in general, and to better understand pressing environmental issues, such as Global Change, Biodiversity and Marine Ecosystems, Geo-hazards, which t threaten the daily life and the economy of European and Worldwide societies.

This document represents the common vision of the Assembly of Members, the Executive Committee and myself for EMSO ERIC's successful development during its critical initial start-up years. As such, it is a living document which will be updated regularly as the infrastructure grows, the path forward evolves and an ever-increasing numbers of scientists, engineers, technicians and managers come together to spur this fantastic example of cutting-edge EU scientific excellence ever forward.

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I. INTRODUCTION

EMSO is a brand-new pan-European Research Infrastructure based on an integrated system of Regional Facilities. It is aimed at the long-term multidisciplinary observation of the seafloor and the water-column by means of fixed-point multi-sensor platforms deployed in scientifically relevant key-sites of the European seas. EMSO's main scientific objective is the observation and recording of physical and environmental variables, at an unprecedented resolution, with the ultimate goal to understand the complex interactions between the geosphere, the biosphere and the hydrosphere and address the major present challenges in the thematic areas of Climate Change, marine Ecosystems and Geo-Hazards.



Fig. 1 – Locations of EMSO Regional Facilities and Test Sites

EMSO distributed infrastructure currently comprises eight Regional Facilities and three test sites strategically located all the way from the North Atlantic through the Mediterranean to the Black Sea (Fig. 1) which provide essential data and services to understand global environmental processes and to stimulate the development of new technologies and knowledge that will allow Europe to lead marine environmental research.

EMSO reached the legal status of ERIC, European Research Infrastructure Consortium, on 1st October 2016 thus becoming an international organization with its own autonomy and organization as for the Statutes published on the Official Journal of the European Union L268/113.

This document aims to present the Strategic Plan of EMSO guiding EMSO long-term implementation and development in terms of governance and operations. It sets the perspective for the position and role that EMSO ERIC must achieve in the coming years to ensure long-term sustainability of the infrastructure operations and the continuous update of its cutting-edge technology.

The document illustrates EMSO's overall mission, and its place within the landscape of European and international environmental research infrastructures and.

This first Strategic Plan (2018-2020) presents the master plan for achieving top-class scientific objectives in the environmental marine domain by virtue of its innovative distributed organizational structure in which a Central Hub oversees and facilitates dependable access to the high-quality data and services provided by 11 geographically-dispersed infrastructure facilities to a very broad range of users.

II. THE MISSION

The EMSO infrastructure offers scientists an unprecedented, powerful new tool for understanding ocean dynamics driving Earth's ecosystems and the complex forces controlling climate on a global scale. Earth volcanism occurs for 70% in the ocean floor, which is also source of other natural risks which are often unpredictable such as earthquakes, tsunamis and steep-slope sliding. For the first time, EMSO is able to provide continuous key data for understanding the processes in the deep marine environment that form the basis for predictive models on short-, intermediate- and long-term global change, from episodic catastrophic events to slow trends that are difficult to discern from the overlying variability of short-term processes. The continuous, high resolution, long-time-series collection of multiple variables at crucial fixed sites across a breadth of environments pursued by EMSO t allow for totally new approaches to shedding light on the the complexities of the Earth System. EMSO multi-parameter long time-series are invaluable to document and study a broad range of critical episodic events such as earthquakes, submarine slides, tsunamis, benthic storms, biodiversity changes, pollution, and gas hydrate (methane) release, dense water cascades, plankton blooms, water mass movements and the influence of eddies, - most impossible to detect by classical short-term marine expeditions. Climate change, ocean ecosystem disturbance, and marine hazards and the urgent scientific and societal challenges are at the heart of EMSO's mission and its *raison-d'être*.

Summarizing, EMSO's mission centres on:

- The establishment of a comprehensive multi-sensor system in the water column, seafloor, and sub-seafloor as part of an integrated system of distributed ocean observation;
- The provision of relevant data at an unprecedented resolution, consistency, comparability, and continuity at the regional scale;
- The constitution of the baseline and the track of the critical changes;
- The delivery of knowledge and tools to enable Europe to evaluate and outlook strategies to hopefully mitigate harmful effects by preparing and adapting to these changes;
- The support and acceleration of the innovation through the scientific and technological research.

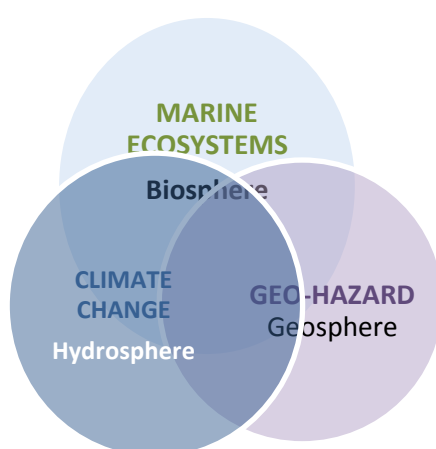


Fig. 2 - The three main pillars in EMSO

EMSO allows the pooling of resources, capacities and expertise, and coordination to assemble harmonised data into a comprehensive regional ocean image, which will be made available to researchers and stakeholders worldwide via an open and interoperable data access system.

The main impact expected from EMSO implementation and development includes

- Create Services and products for the stakeholders (e.g., Copernicus and EMODNET) to understand, manage the consequences and tackle climate change, ocean acidification, natural risks and deliver outstanding information and appliances to understand the interacting processes in the marine environment among other key topics.
- Improve the health of our oceans through the research and the interdisciplinary approach in the framework of a European-international collaboration with other environmental research infrastructures, programmes and initiatives
- Exploit EMSO ERIC as a source of knowledge, information and education to advance oceanic literacy and understanding of the phenomena that affect our daily life and our economy through initiatives such as EU Blue Growth, taking advantage of the potential of Europe's oceans for the creation of blue jobs and economic growth.

- Commit to answer to societal environmental needs encouraging a close collaboration with industry by means of joint initiatives or explicit actions in promoting innovation in products and technological processes.

III. THE STRATEGIC VISION

EMSO ERIC's vision is to become a world leader in Marine Environmental Sciences and Technology, launching a new type of large-scale infrastructure that delivers deep ocean and water column high-quality data with unprecedented time resolution and contributes to face the Global Marine Environmental Challenges of the 21st century.

EMSO ERIC's objective is to become a leading player in the framework of the future *European Ocean Observing System* and a scientific partner of choice for counterpart infrastructures operating worldwide in respect to support:

- Understanding and preparing for Climate Change
- Mitigating the impact of Geo-hazards
- Preserving Marine Ecosystems
- Understanding the complex interactions among the Geosphere, Hydrosphere, and Biosphere
- Developing integrated solutions for the Blue economy
- Advancing science-based Ocean Policy
- Enhancing Copernicus applications, products and services
- Implementing European policies and strategies (e.g., MSFD-Marine Strategy Framework Directive)
- Developing technologies to improve the environmental monitoring, measurements quality, and supporting logistics.

Moreover, EMSO ERIC aims at becoming a major player in European environmental strategies and Strategic Development Goals

The accurate and timely environmental information gained with EMSO will nourish mitigation and protection strategies against important challenges and threats, such as natural disasters, habitat loss, human and animal migration, and food security, together with the deprivation due to marine-related industry activities, tourism, and recreation.

EMSO offers exciting opportunities for making real new hi-tech jobs, and spurring development of innovative applications and services in strategic marine-related industry sectors such as blue biotechnology, seabed resources, deep-sea mining, marine renewable energy, fishing and tourism.

By the installation and operational phases, EMSO has already started and will continue generating significant socio-economic benefits such as: advanced training and support services (incubator,

testing) for industry, particularly for SMEs; high-quality educational content and services for academia and media; a one-stop-shop world-class reference point and lobby group for marine research policy, innovation and ethics for government; and education and citizen science interactivity for the general public.

A. EMSO ERIC STRENGTHS

EMSO ERIC is the coordinating hub of an integrated system of Regional Facilities: diverse disciplinary and operational expertise and a broad range of marine environment across EMSO Regional Facilities allow accomplishing scientific and technological objectives on scales larger than those achievable individually by each Regional Facility. Strong Member cohesion and engagement as for 2017 All Regions Workshop participation is the engine of this continental scale infrastructure.

EMSO ERIC's strengths are:

- the distributed configuration, dimension and multidisciplinary feature of the research infrastructure ensuring appropriate observation approach of the marine environment phenomena through
 - 8 Regional Facilities strategically distributed in European seas and equipped with a wide range of instruments;
 - Continuous long time series data flowing from the Regional Facilities and covering a wide range of environments from sub-arctic to sub-tropical;
 - Extensive range of science and technology expertise across the Members and the scientific institutions managing the facilities;
 - 3 Test Sites serving development and experimentation of new devices, systems and methodologies to improve observation capacity;
- The coordination function of the ERIC and the direct involvement of the Regional Facilities managers and teams in the ERIC executive and operative levels (Executive committee and Service Groups) to
 - Harmonise Instrument/observation/logistic
 - Unify the data management according to an open access approach
 - Operate core and integrated services to meet users' and stakeholders' requests
 - Pursue the integration and interoperability within European initiatives and e-infrastructure frameworks such as EMODNET and European Open Science Cloud (EOSC).
- The recognised influential EMSO ERIC role to develop an excellence research environment for

- Advancing the knowledge and understanding of the Earth System natural processes and components interactions
- Accelerating marine scientific community capacity building, training and education
- Coordinating global goals and action plans
- Cooperating regional, European and worldwide actions

B. THE CHALLENGE OF THE EMSO ERIC DISTRIBUTED MODEL

EMSO ERIC represents a world-class marine infrastructure integrating Regional Facilities deployed in strategic locations under the coordination of EMSO ERIC with the ultimate goal of sustaining the science excellence through the provision of services to users and stakeholders. The scheme is described in Fig. 3.

EMSO distributed configuration poses challenges relates to

- The nonstop operation of the Regional Facilities and the acquisition of high-quality time-series an unprecedented resolution
- The development of an integrated data infrastructure under the coordination of EMSO ERIC based on distributed data facilities
- The effectiveness of EMOS ERIC core and integrated Services in meeting users' needs

Additional challenges more directly related to the success and the long-term sustainability of the RI are represented by

- The attraction of a broad spectrum of multidisciplinary users and stakeholders by long-term engagement
- The progressive expansion of the infrastructures with existing and new platforms toward an even coverage of the European Seas specially in the Arctic region and a highest representativeness of the measurements.

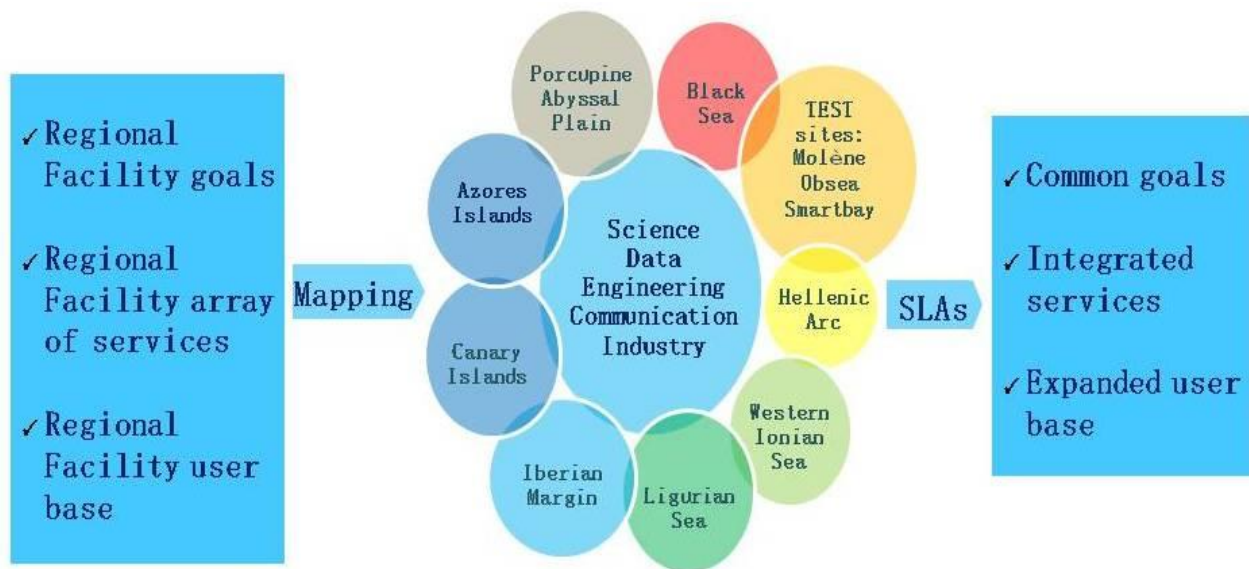


Fig. 3 - Logical scheme of facilities vs services vs users

C. EMSO ERIC SERVICES

EMSO ERIC's broad range of disciplines (from geophysics and oceanography to ecology, microbiology, and engineering) have the potential to support a large variety of services of great value not only to scientists but also to academic, institutional and industry users. The provision of these top-quality services based on data, data products, instrumentation and physical access are what allow the EMSO RI to have such a great impact on the furthering of knowledge, capacity building, innovation, literacy and education.

The delivery of EMSO services is assured by:

- the Regional Facilities (RFs): organized at each key-site and by the proximity, usually comprise the observing platforms, shore stations hosting the control, communications and data local storage systems. RF's are owned by Member country research institutions which sometimes belong to more than one Country. .;

the Regional Teams (RTs): teams of scientists, engineers, managers and technicians affiliated with the research institutions owning the facilities and with a broad range of expertise vital to the management and operation of the Regional Facilities. The RTs experts are the real engine which enable EMSO ERIC to function successfully. .

- The Central Management Office (CMO) aides and supports the Director General and coordinates EMSO ERIC key activities planned by the Executive Committee (ExCom) and implemented by the Service Groups (SG's) ;

The delivery of EMSO services is assured by the Services Groups (SGs) which are coordinated and facilitated by the CMO. A Service Group Leader, designated to coordinate the various key activities of the infrastructure heads each SG.

EMSO's pillar Services are:

Science Services

A central objective of the EMSO ERIC is to deliver to the stakeholder's quality-controlled data, qualified information and knowledge based on sustained monitoring of environmental processes at EMSO Regional Facilities. Stakeholders in the EMSO ERIC include marine science researchers, marine technology engineers as well as other ERICs, resource managers, policy makers, industries, scholars, training and education operators and the public for both data collection and use.

The structure of the Science Services entails all the steps from developing science approaches, adding value by means of rigorous quality control and user-tailored analysis, and the ultimate supply of data, information and knowledge in a form that is suitable for their needs.

The Science Service will provide data products and user-specific products to the following scientific topics:

- Geo-Hazards: Tsunami, Seismic and volcanic activity, seafloor instabilities, sea-bed fluid emissions
- Climate and Oceanography: Global Ocean warming and acidification
- Marine Ecosystems: health status of the communities from surface to deep-sea, anthropogenic impact, species routes and migrations
- Good Environmental Status indicators (Marine Strategy Framework Directive Services).

Engineering & Logistics Services

Standardization in measuring physical and chemical parameters in the ocean increases the potential scientific impact of the data collected at the Regional Facilities. The long-term recorded data or *in situ* ocean measurements are critical issues not yet resolved, since the sensors suffer extreme ambient conditions, corrosion, high pressures, mechanical stress, sudden changes in temperature and their electronic components supports a remarkable wear. Long-term maintenance should be based on a coordinated action plan agreed primarily with European Research Vessel Operators (ERVO), in order to provide a significant part of maintenance and/or equipment and sensor exchange interventions to nearby regional sites and with the aim of a better use of the resources reducing the costs of the sea operations. Moreover, this will also allow to have a more spatial coverage connecting observatory sites through different recordings on transit of the RVs. This will result to give more significance to the measurements on transit that can be calibrated using the fixed-point measurements as reference.

In addition, the procurement of new sensors for the distributed infrastructure through coordinated actions will benefit the interoperability and standardization of the entire infrastructure; these are logistic actions to be gradually implemented among the members.

The development of EGIMs (EMSO Generic Instrument Modules, see the sketch in Figure 4) is a step forward of the Engineering Services to ensure increased coordination, integration, interoperability and standardisation across sites and disciplines which includes design, acquisition system, testing, implementation and data integration. More specifically the objective is to offer features beyond the state-of-the-art, using a comprehensive set of sensors and devices that meet particular technology readiness thresholds to collect observations including temperature, pressure, salinity, dissolved oxygen, turbidity, chlorophyll fluorescence, currents, and passive acoustics. Relatively novel sensors shall be considered including those for pH, pCO₂, and nutrients. These Essential Ocean Variables (EOVs) can be used and directly address a wide range of scientific topics.

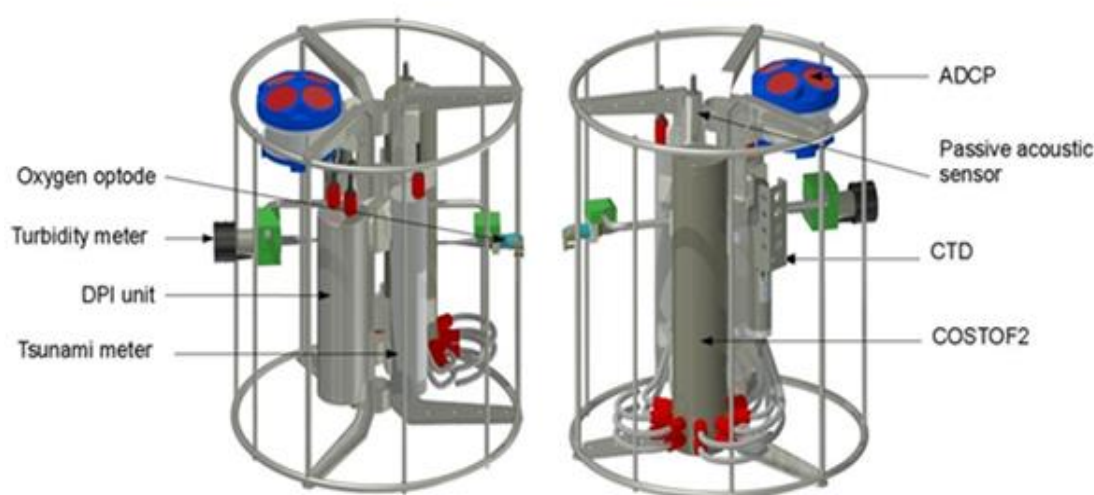


Figure 4. EGIM recording frame structure developed in the EC EMSODEV project for the acquisition of different parameters

Data Management services-

EMSO's data management e-infrastructure supports a massive volume of data from geographically dispersed, multi-parameter observatory platforms to which it directs users via a unique central access point for data and products visualisation and downloading.

The core of the infrastructure (see an outline in Fig. 5) consists of Sensor Observation Service (SOS) Servers and the Data Management Platform (EMSO-DMP). The SOS Server stores the data of the sensors in the facilities of the node owners. The EMSO-DMP communicates with the SOS servers and creates a centralized, data access. The users, portals and tools obtain/download the data through requests to the EMSO-DMP. Data obtained with the EMSO-DMP is standardized, enhancing interoperability between different oceanographic data platforms, such as EMODnet or OceanSITES.

Additionally, tools are implemented to inform users that sensors are working correctly and to conduct studies with the data, such as the Sensor Monitor Dashboard (SMD) and the Module for Ocean Observatory Data Analysis (MOODA), respectively. The SMD is a tool that helps technicians

know if a node is working correctly. The SMD is a web tool that reads data directly from the nodes, before the connection to the EMSO-DMP. This tool is for use of the technicians, not for the final users. MOODA is a Python package (it is an offline tool) that allows customizable Quality Control functions, filtering, displaying, labelling ocean variables, save data in different formats (NetCDF and CSV according to OceanSites specifications) and statistical functions, to analyse EMSO data with a few lines of Python code and a Graphical User Interface.

This platform is compliant with other data infrastructures, such as **EMODnet** and the European Open Science Cloud (**EOSC**) and is thus at the service of innovation.

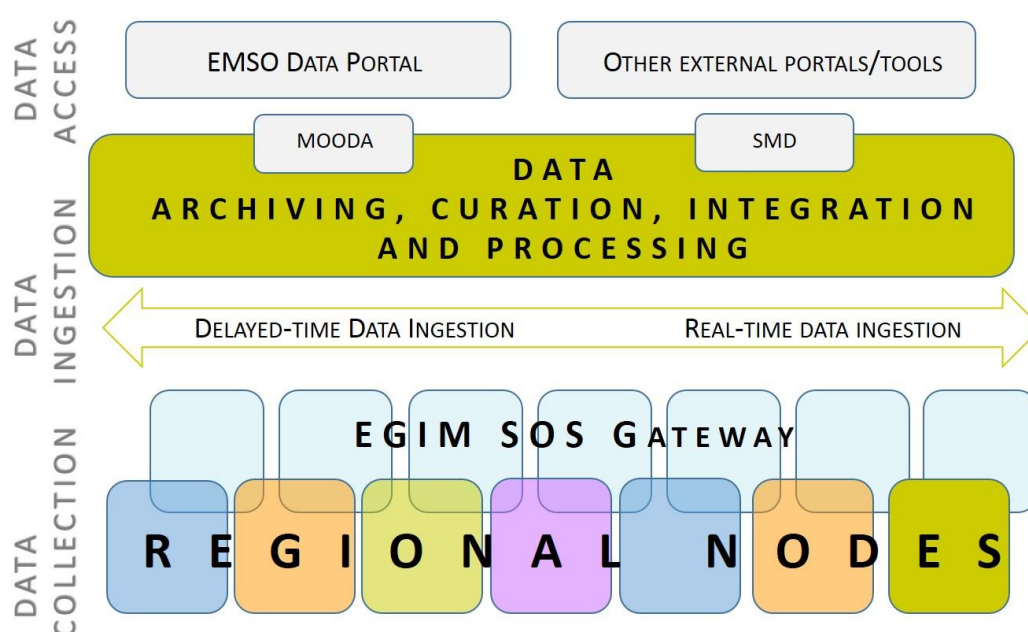


Fig. 5 – Data Management in EMSO: components from the Regional Facilities (bottom) to the access services (top)

Industry & Innovation Services

Industry's main interests relative to marine-related services and applications are focussed predominantly on cooperation with EMSO in key sectors like renewable energy, deep-sea mining, oil & gas extraction, fisheries optimization, and geo-hazard mitigation. Thus the priorities for EMSO in its interaction with the private sector are encouraging the development of advanced technological research in marine sensors together with the offshore industry, and establishing an Innovation Services Unit or Hub made up of selected communications and innovation staff drawn also from other RIs, to facilitate and promote technology transfer and commercialization opportunities together with industry.

Communication Services

Increasing the visibility of the new pan-European Research Infrastructure EMSO ERIC to the scientific community, the policy makers and business communities, as well as to the wider public is of utmost importance. EMSO major role is for spreading the message that the European marine sciences are entering in a new knowledge paradigm which encompasses a holistic vision of the Earth and a multidisciplinary and interdisciplinary approach to study its processes. The core EMSO activities and the major steps forward in the advancement of sciences, as well as scientific and innovation opportunities are spread and brought to the attention of the interested stakeholders and in particular of the scientists, of the industry, of the public and of the policy makers also to promote new business development. While EMSO communications address the various categories of stakeholders through dedicated channels, communication internal services are looked after as they are crucial for a geographically distributed organisation such as EMSO ERIC which has to keep together the national and the European dimension.

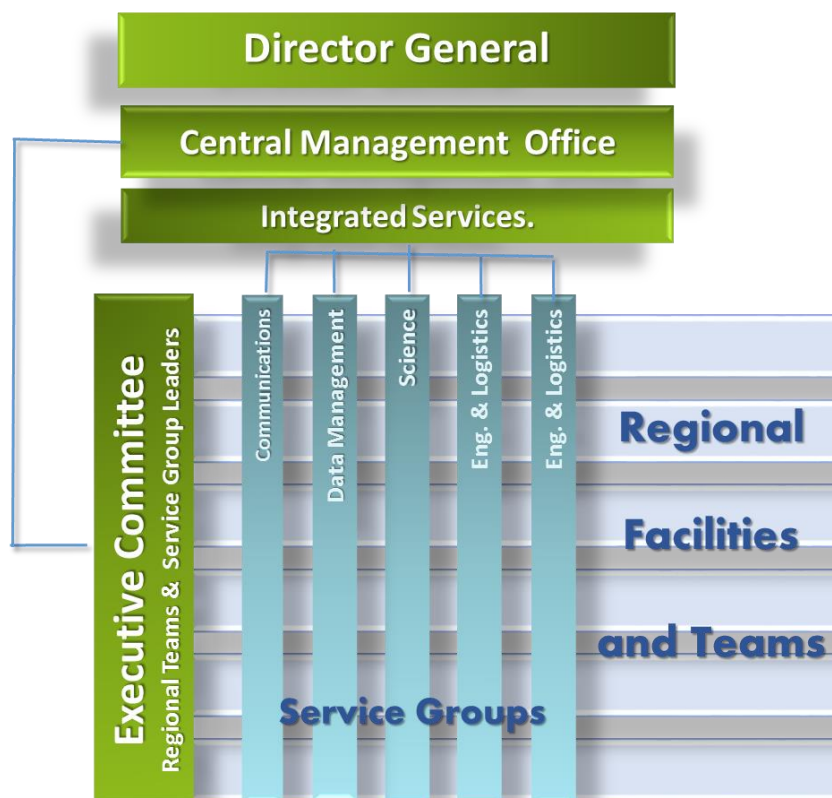


Fig. 6 – Services connection to EMSO ERIC Governance and to Regional Facilities/Teams.

IV. THE ENVIRONMENTAL RIs LANDSCAPE

EMSO is a Landmark infrastructure in the ESFRI Roadmap 2016 (www.esfri.eu/roadmap-2016), with a remarkable multi-domain peculiarity addressing multidisciplinary investigations of the interactions among geosphere, biosphere and hydrosphere.

EMSO ERIC operates a coordinated system of fixed observatories developing a Eulerian approach to time series recording of the environmental physical parameters from the seafloor, sub-seafloor, and the water-column up to the surface.

EMSO complements other environmental research infrastructures both on the spatial and on the disciplinary ranges and can then encourage fruitful cross-fertilisation and inter-RI services.

ESFRI Landmarks and projects are:

- LifeWatch – an e-infrastructure for Biodiversity and Ecosystem Research is a distributed RI to advance biodiversity research and to address the big environmental challenges and support knowledge-based strategic solutions to environmental preservation;
- EuroARGO- an array of drifting and profiling floats measuring temperature, salinity and other variables throughout the deep global oceans, down to 2.000 meters, to deliver data both in real-time and delayed mode;
- ICOS - delivering high-precision data and integrate knowledge on the carbon cycle and greenhouse gas budgets and of their perturbations.
- ESFRI Projects are:
- EMBRC providing services to users from academia, industry, technology and education in all sectors in the fields of marine biology and ecology, particularly supporting the development of blue biotechnologies;
- DANUBIUS supporting interdisciplinary research on large river-sea systems.

EMSO ERIC has already established fruitful links and exchanges with the main worldwide Ocean Research Infrastructures which are natural counterpart of EMSO and all together are committed to contribute to a long-term international collaboration among environmental RIs on common grand challenges and to proactively establish a long-term common work framework.

Leading international RI counterparts with which EMSO cooperates with are : (see Fig. 7):

ONC - Ocean Networks Canada (Canada), which monitors the west and east coasts of Canada and the Arctic to continuously deliver data in real-time for scientific research that helps communities, governments and industry make informed decisions. Using cabled observatories, remote control systems and interactive sensors, and big data management ONC enables evidence-based decision-making on ocean management, disaster mitigation, and environmental protection.

OOI - Ocean Observatories Initiative (USA), funded by the National Science Foundation, OOI is an integrated infrastructure program composed of science-driven platforms and sensor systems that measure physical, chemical, geological and biological properties and processes from the seafloor to

the air-sea interface. The OOI network was designed to address critical science-driven questions that will lead to a better understanding and management of our oceans, enhancing our capabilities to address critical issues such as climate change, ecosystem variability, ocean acidification, and carbon cycling. The OOI has transformed research of the oceans by integrating multiple scales of globally distributed marine observations into one observing system and allowing for that data to be freely downloaded over the internet in near-real time.

DONET - Dense Ocean floor Network for Earthquakes and Tsunamis (Japan) is part of the JAMSTEC Earthquake and Tsunami Research Project for Disaster Prevention and consists of a real-time (cabled) seafloor observatories deployed in the focal region of the Tonankai and Nankai earthquakes. The system aims at capturing evidence of earthquakes, crustal movements, and tsunamis, contributing to rapid detection and simulation study of seismic shaking and tsunamis, facilitating disaster prevention and mitigation.

IMOS - Integrated Marine Observing System (Australia) is a national research infrastructure widely used by the Australian research community to deliver science outputs of relevance to users and stakeholders. It is a truly integrated systems of mobile (ARGO buoys), fixed (deep ocean moorings) and costal (ocean radars) facilities operated by Universities, publicly funded research agencies, federal and state agencies in a national collaboration framework. IMOS undertakes national science and implementation planning, integrated across regions. Since 2011, IMOS has had responsibility for managing Australia's national ocean data facility, including metadata and data from many other organisations.

ECSSOS - East China Sea Seafloor Observation System (China) is a seafloor observation system in the East China Sea. It is an attempt to meet the increasingly prominent needs from scientific research, engineering construction, resource development, environment monitoring, and protection. The major scientific topic that are addressed within ECSSOS is sea-land interactions, being the East China Sea a marginal sea over a broad continental shelf located between the largest continent (Asia) and the largest ocean (Pacific) in the world. Construction contents of ECSSOS are expected to range from the fixed cabled seafloor observatory infrastructure to the dynamic observation subsystem based on autonomous underwater vehicles (AUVs), gliders, and moorings.



Fig. 7 - EMSO and equivalents marine research infrastructures in the world

V. SUSTAINABILITY

The financial sustainability of EMSO ERIC in the period 2018-2020 derives mainly from the contributions of the Members (~60%). While this funding is sufficient to keep the infrastructure functional at least till 2019, scale-up of the operations and structural assets requires procurement additional funds, from EU (R&D Framework Programmes, Structural and Investment Funds, etc.) and other sources (industry, advice, services, etc.).

In particular, it is worth to remind that EMSO ERIC will be subject to an assessment by EC through ESFRI in the period 2018-2019. In order to have a competitive position for facing this stage, it is mandatory for EMSO ERIC to bring the core services operation to the regime in the short-term. This goal soon demands a strong investment in human resources both at the CMO level and distributed at the regional facilities in the form of in-kind. In the short- medium-term EMSO shall exploit the internal resources for the design, development and gradual operation of integrated services which are the tangible added value respect to the services that the individual Regional Facilities are capable to provide. Integrated services have the potential to become a distinctive peculiarity of the infrastructure.

The table 1 and diagrams (Fig. 8) below summarise the resources related to the EMSO ERIC participation to H2020 projects and the resources from the Members' fees.

Projects (€)	Total budget	2016	2017	2018	2019	2020	2021
EMSO-Link	539'926	-	99'226	205'000	205'000	29'162	-
DANUBIUS-PP	47'188	-	-	11'797	35'391	-	-
ENVRI PLUS	72'556	-	-	54'417	18'139	-	-

ENVRI FAIR	511'327	-	-	-	150'000	150'000	150'000
ERIC FORUM	44'166	-	-	-	14'722	14'722	14'722
EUROFLEETS PLUS	149'500	-	-	-	49'833	49'833	49'833
Tot projects	1'364'663	-	99'226	271'214	473'085	243'718	214'555
Member fees (€)	Total fees	2016	2017	2018	2019	2020	2021
IT	1'320'000	220'000	220'000	220'000	220'000	220'000	220'000
PT	195'000	20'000	35'000	35'000	35'000	35'000	35'000
GR	195'000	20'000	35'000	35'000	35'000	35'000	35'000
ES	195'000	20'000	35'000	35'000	35'000	35'000	35'000
RO	195'000	20'000	35'000	35'000	35'000	35'000	35'000
IE	195'000	20'000	35'000	35'000	35'000	35'000	35'000
UK	195'000	20'000	35'000	35'000	35'000	35'000	35'000
FR	195'000	20'000	35'000	35'000	35'000	35'000	35'000
Tot fees	2'685'000	360'000	465'000	465'000	465'000	465'000	465'000
TOT	3'986'798	360'000	564'226	736'214	938'085	708'718	679'555

Table 1 - List of EMSO ERIC funding sources (2016-2021) by EC projects (top) and by the Members (bottom)

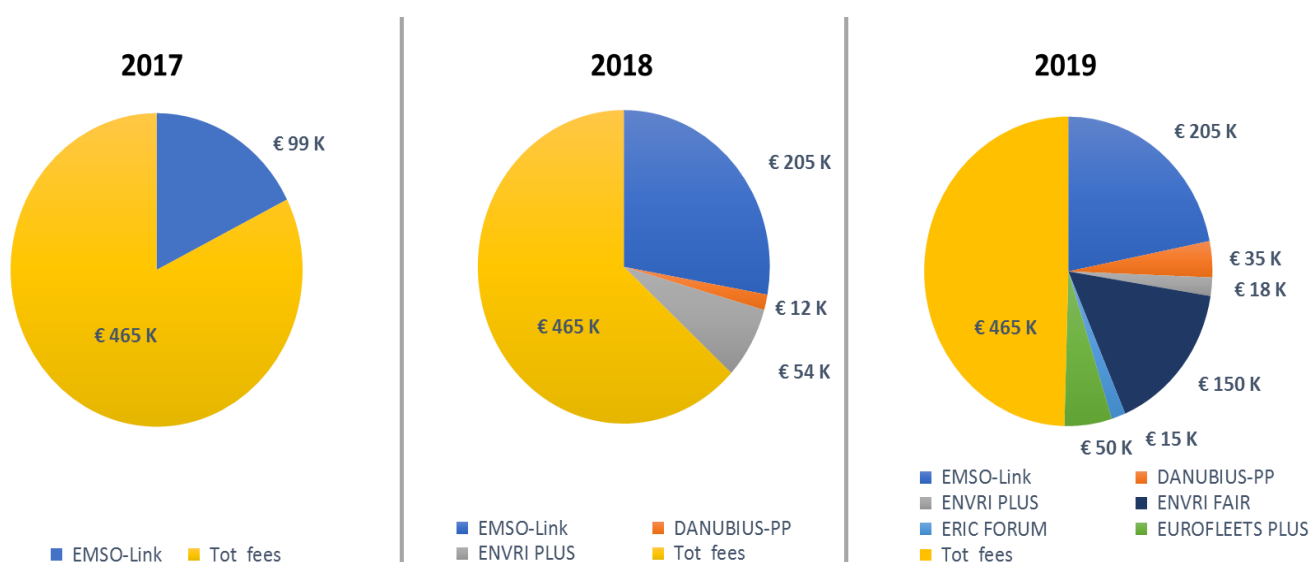


Fig 8. Evolution of the funding from members fee and external financing

Currently EMSO ERIC is involved in two EU H2020 projects: EMSO -Link^(a) as coordinator, and DANUBIUS-PP^(b) as partner. The funding coming from these two projects corresponds to ~40% ^(a) 2017-2020; ^(b) 2016-2019).

EMSO ERIC strategy of participation to other H2020 new proposals has followed the goal

- to develop strong and long-lasting connection to other environmental research infrastructures becoming an integral component of and ecosystem of RIs
- to integrate EMSO RIC services to those of the other RIs
- to be proactive in the establishment of common approach in the RI management in the broad sense

EMSO ERIC has already registered initial successes in 2018 with the approval of the following projects:

ENVRI FAIR - it gathers again the environmental RIs already collaborating in ENVRI Plus. ENVRI FAIR focuses the RIs' efforts on the principles of FAIR data (Findable, Accessible, Interoperable, Reusable) to develop advanced solutions for the effective provision and use of high-quality scientific data. These efforts contribute to shaping the EOSC, including its governance model, fully reflecting the engagement and responsibility on open science.

ERIC FORUM – it is a follow-up of a previous networking effort of Managers of existing ERICs and scientists of future RI who want to use the ERIC instrument, discuss shared challenges, meet also national policy makers and establishing a platform for exchange of solutions and best practices. During 2017 the then existing ERICs have agreed to form a more formal structure and process of interaction and have developed and signed a Memorandum of Understanding to form an ERIC Forum with the objectives to further intensify collaboration between ERICs.

EUROFLEETS Plus – It is a follow-up of previous infrastructural projects of the same names and addresses the management of research vessels across Europe, and internationally to provide support for complex, multidisciplinary, multi-investigator research. The project includes state of the art technology and instruments to serve research and innovation needs for a large number of different end user communities.

VI. EMSO ERIC IMPLEMENTATION PLAN 2018-2020

EMSO ERIC delivers high-quality data for the understanding the mechanisms of fundamental processes and their interactions that occur in key environmental sites of the sub-seafloor, seafloor and water column providing multidisciplinary explanations to address assessments and develop temporal and spatial evolving models to explain and / or mitigate the global environmental challenges that affect the Earth.

In the incoming years (2018-2020) many important goals must be pursued:

2018: Create and start-up a reliable Action Plan

The Director General and the Central management Office support the configuration and push the regime operation the different bodies that are essential to run-up a large and distributed Research Infrastructure (i.e. Head of the Regional Teams, Lead of the Services Groups, Executive Committee,

to complete the Advisory Committee). EMSO ERIC is adopting an Activity Plan through an internal shared process relying upon the contribution of the Executive Committee and the Service Groups. The implementation of services taking advantage of the valuable legacy of FixO3 swiftly and the elaboration of a catalogue of services is a priority. The ESFRI Landmarks assessment process is considered a stimulus to progress toward the full operation.

A Service Level Agreement template is drafted and submitted to the Executive Committee for integration and for testing the viability and the adaptability to the different Regional Facilities,

The potential of running EU H2020 projects like EMSODEV, EMSO-Link, and DANUBIUS-PP is used as they represent today more than 40% of the funding resources.

It is a strategic priority to incorporate into the Consortium other European countries such as Germany and Norway, with a significant position in the Arctic. The formal involvement of the Germany demands additional efforts although German institutions have been participating to EMSO ERIC development projects and are very proactive on the data management issues. The participation of Norway has been announced and negotiation are now running.

A cooperative agreement is close to be signed with ONC Canada facilitating exchanges of information and personnel promotion.

2019: Execute the Action Plan delivering outstanding services

In the **2nd Year** (2019), the consolidation of the Services is planned and major effort will focus on the development of integrated data management services by incorporating in the CMO a Data Manager with proven experience. This can ensure sustainability, appropriate participation to projects and potential leadership in new Calls.

a new Innovation and Industry Liaison Service Group will be launched to approach SME's for joint venture and innovation process and to feed the activities of the Industry and Innovation Service Group.

EMSO ERIC is going to join ENVRI FAIR EC project to reinforce a cooperation model with other Environmental RIs. A Risk Management Plan is expected. EMSO ERIC shall formalize an environmental policy according to its activity and responsibility in this matter in the European seas. The expansion to other central-eastern Mediterranean country (e.g., Turkey, Cyprus and Malta) that already have expressed the willingness to join will be encouraged.

2019, according to the Statutes, EMSO ERIC Members will have the discretion to negotiate the Member financial engagement. Under this perspective the Annual Activity Report will be a fundamental tool to highlights strength points and weak points of the Statutes, the Implementing Rules and the managerial approach.

2020: Consolidation and evaluation of new challenging services.

In the **3rd Year** (2020), EMSO ERIC will implement the analysis of the Key Performance Indicators (KPIs), viability, and risk management of distributed RI.

Exploratory evaluation to see the viability in the implementation of regional thematic services focused on difficult and extreme areas promoting greater cooperation among the Member States in the same marine region.

Harmonize an integrated and active policy in communication and outreach. Improve relationships and establish MOUs for collaboration with other International ocean observing programs.

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