



**EMBRC**

EUROPEAN  
MARINE  
BIOLOGICAL  
RESOURCE  
CENTRE

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# European Marine Biological Resource Centre (EMBRC) – Technical & Scientific Description

(ERIC Application – Stage 1)

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## 1 - Introduction

Europe played a key-role in the creation of marine stations, in the second half of the XIXth century. These undertakings, which happened within a short period of ca. 30 years in a number of European countries, were prompted by the necessity to study in details the evolution of life, which originated and developed in the oceans, and to understand the diversity and sustainability and exploitation of marine life. In a number of Member States and Associated Countries these marine biological laboratories today harbour a vibrant technical and scientific community, dedicated to the investigation of marine organisms and ecosystems.

Marine biodiversity constitutes a major resource for fundamental science. With the onset of genomics and the related post-genomics experimental approaches in marine biology and ecology are becoming as sophisticated as in “terrestrial” biological and ecological sciences. This fundamental shift, which brings marine life into forefront biology, widens the scientific scope of marine models organisms. Marine biodiversity is an increasingly important resource for food, energy and industrial applications and therefore constitutes a focus for an increasingly diverse RTD community.

EMBRC will be a distributed research infrastructure (RI) with nodes located in renowned marine biological stations and institutes across Europe. EMBRC will give access to critical components of national facilities necessary for marine biological research so as to create a comprehensive and complementary resource. It will provide the fundamental and applied research communities with the necessary and relevant services, facilities and equipment to access and study marine ecosystems and biodiversity.

The EMBRC concept originated in the FP6 Network of Excellence “Marine Genomics Europe” (MGE)<sup>1</sup>, where the necessity of defragmenting the community of marine biologists through sharing of “omics” technologies and infrastructure was first underlined. The FP7 Integrated Infrastructure Initiative (I3) project, “Assembly of European Marine Biological Laboratories” (ASSEMBLE)<sup>2</sup> was the first step towards formalizing this concept.

A Memorandum of Understanding to establish a legal structure to operate EMBRC (EMBRC MoU) entered into force in December 2013 and has now been signed by seven EU member states (Belgium, France, Greece, Italy, Portugal, Spain and UK) and two associated countries (Israel and Norway). France was selected to host EMBRC, with a Core Office in Paris. The nine countries taking part in the EMBRC negotiations share a common vision: 1) to deepen fundamental knowledge on marine organisms and ecosystems; 2) to promote the use of marine experimental models in mainstream science and raise the profile of marine biological sciences; 3) to promote the sustainable development of marine biological resources; and 4) to promote the blue bio-economy of marine territories in Europe.

<sup>1</sup> <http://www.euromarineconsortium.eu/fp6networks/marinegenomics.html>

<sup>2</sup> <http://www.assemblemarine.org/>

The objectives of the established and operational EMBRC will be to:

- 1) Offer users from academia and the private sector access to a portfolio of research platforms, biological resources, analytical services and data (see 2.1, 2.2 and 3.2);
- 2) Develop integrated workflows of high quality services for access to biological, analytical and data resources by deploying common underpinning technologies and practices (3.3);
- 3) Strengthen the connection of science with industry through a coordinated knowledge and technology transfer service (3.4);
- 4) Offer training facilities and courses for researchers and technical personnel (3.5);
- 5) Collaborate and engage European maritime regions in the development and integration of EMBRC and contribute to de-fragment their RDI policies (3.6).

## 2. EMBRC technical and scientific design

### 2.1. EMBRC technical and scientific scope

EMBRC will be a distributed RI, integrating national nodes with strong track records in research, training and servicing the science community. Based on the current configuration of EMBRC national nodes an outlay of projected EMBRC laboratories is shown in Figure 1.



**Figure 1. Distribution of EMBRC laboratories in Europe**

These research laboratories host world-class in-house research communities and state-of-the-art infrastructure, with staff ranging from ca. 50-300 people. They share similar typologies, notably: (i) access to unique marine ecosystems and biological resources, including access to wet labs and culture collections, and (ii) on-site support for genomics, post-genomics and bioinformatics. Many of the research communities have a high-impact track record of international collaboration involving several EMBRC laboratories in various FP7, ERA and H2020 projects, having demonstrated excellence in science and strategic coordination over many years.

The EMBRC infrastructure will enable marine biological research and industrial R&D by offering standardised access to a range of services:

- marine ecosystems, including associated historical time-series data;



- marine model organisms for academic and industrial research purposes;
- logistics for ex-situ maintenance and experiments, including wet labs and up-to-date equipment for biological research (“omics”);
- rare and unique facilities for specialist research purposes, (e.g. bioreactors, micro- or meso-cosms, marine mammal holding tanks, greenhouses);
- biological and environmental data and bioinformatics;
- teaching/training laboratory space and conference facilities, including logistics for hosting and catering visiting scientists

For each infrastructure site, the quantity of access to the components of EMBRC will be negotiated with national nodes as a fraction of the total capacity of access available and depending on the needs of resident research. Typically up to 20% of the total access capacity will be offered for access via EMBRC. A common access system will be established and user access harmonised among all nodes.

## **2.2. Operating as a distributed venture:**

The EMBRC service offer is carried out in marine research institutes operated by research performing organizations, organized nationally into EMBRC nodes. In order provide seamless delivery of services different instruments will be in place:

The EMBRC-ERIC Statutes, which are the set of rules of procedure for the government and management of EMBRC-ERIC operation,

The service-level agreements (SLA), which are the agreements between EMBRC and legal entities operating the Nodes and regulating the provision of services and resources to support the high level ambitions of the RI. These agreements will limit the range of the ERIC General Assembly decisions to the inventory of activities of each node and will also ensure the commitment of the operators towards EMBRC.

Certification of the Infrastructure’s management system under an internationally recognized norm will provide EMBRC with the necessary management tools to monitor, control and improve working practices throughout the entire organisation and will be the first step of a process of continual improvement to maintain the highest standards at all times and at every level of the organisation.

Public Procurement Policy, EMBRC will develop a policy regarding the acquisition of new equipment and facilities that will set the basis for the investment on the RI and will ensure the best use of the available resources. Apart from these instruments, the governance of the ERIC will ensure efficient functional organization:

Committee of Nodes, composed by representatives of the national facilities, this non-executive body’s role will be to support the actions of the Executive Director and help in the implementation of the ERIC’s decisions. The representatives on the Committee will be appointed by the operators of the research facilities and a chair will be elected amongst its members

Liaison Officers will be placed in each node, they will be part of the EMBRC Secretariat and will act under the full responsibility of the Executive Director. Their role will be to liaise with the national node’s team on the operation of the infrastructure and to ensure the EMBRC

standards and SLAs are fulfilled. The EMBRC liaison officers will meet regularly to facilitate the exchange of best practices amongst the nodes.

Access Officers will be placed by the operators at the facilities where the access to EMBRC services is granted to provide support to the visiting scientists with any practicalities related to their stay.

The organizational structure and legal instruments enable strong interaction from European to local level and will help the Executive Director to monitor the portfolio of resources and the quality of services.

### **2.3. The EMBRC user community.**

EMBRC Key Thematic Areas are the following:

- Marine biodiversity and ecosystem functioning;
- Integrative biology and evolution;
- Biogeochemistry and global change;
- Marine products and resources (biotechnology, aquaculture, fisheries);
- Biomedical science.

The EMBRC user community covers a very wide panel of scientific fields, using approaches as diverse as molecular and cell biology, biochemistry, genomics, behavioural and reproductive biology, ecology, population genetics and host-pathogen relationships. Application sectors range from gene and cell engineering (molecular farming, cell factories), bio-refineries, biostatistics, software development, nutrition, medicine and health care, aquaculture, crop disease control and environmental remediation, to bioenergy and biomaterials.

A main relay in linking EMBRC with the marine biological science community is EuroMarine<sup>3</sup>, a bottom-up organization formed in 2013 by the consolidation of three former FP6 marine Networks of Excellence (MarBEF, EUR-OCEANS and MGE) in order to contribute to setting the research agenda in marine sciences in Europe. The EuroMarine partnership spans 17 European member states as well as 5 non-European countries. The scientific scope of EuroMarine ranges “from genes to ecosystems”, highlighting the key role of genomic approaches in marine biology and oceanography. It recognizes EMBRC as a major infrastructure partner, while EMBRC sees itself as a major “hardware” resource for this scientific community. Creating strong ties and collaborations with Joint Programming Initiatives (JPIs) and ERA-Nets will also be pursued to comprehensively cover Europe’s research community.

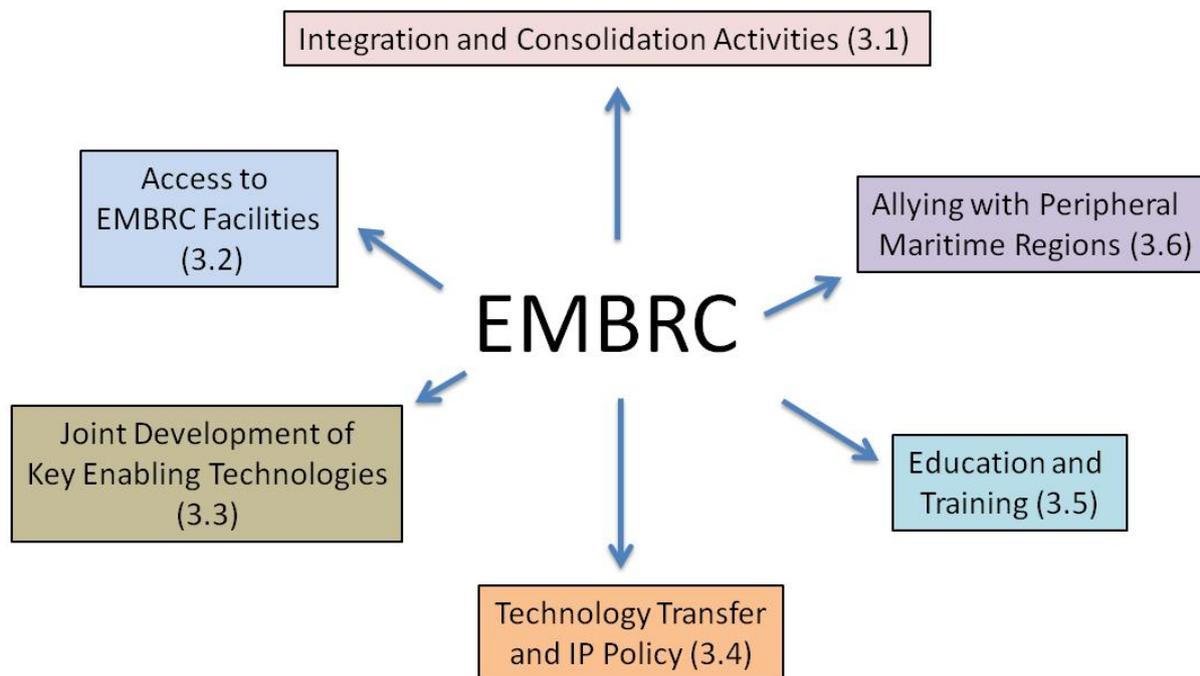
EMBRC will also link with other, non-marine communities, including those of other ESFRI RIs. RIs in the biological and environmental sciences constitute important relays to novel user communities, especially to users who wish to pursue research workflows through services of multiple RIs (enabled through H2020 Infradev-4 projects), to make marine resources available for industrial applications (European Marine Biological Resource Infrastructure Cluster (EMBRIC)), to adapt marine model species for novel applications in biomedical and fundamental biological research (Coordinated Research Infrastructures Building Enduring Life-science Services (CORBEL)) and to integrate data and methodologies across different environmental sciences (Environmental Research Infrastructures Providing Shared Solutions for Science and Society (ENVRI+)). These projects are powerful tools for

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<sup>3</sup> <http://www.euromarinenetwork.eu/>

solidifying the RI communities as well as making all of the public and private research communities aware of their existence and the possibilities they offer.

### 3. EMBRC activities



**Figure 3:** Flow (PERT) chart explaining primary EMBRC activities, outlined in detail in Section 3.

#### 3.1. Integration and consolidation of EMBRC

The integration and consolidation activities in EMBRC (figure 2) will consist of:

Planning and operating EMBRC portfolio of services: monitor emerging scientific issues in marine biology and ecology, organize joint development activities (JDA, see 3.3, below); coordinate and promote joint TT activities (3.5); detect the appropriate calls where EMBRC can apply and coordinate the submission and implementation of the proposals.

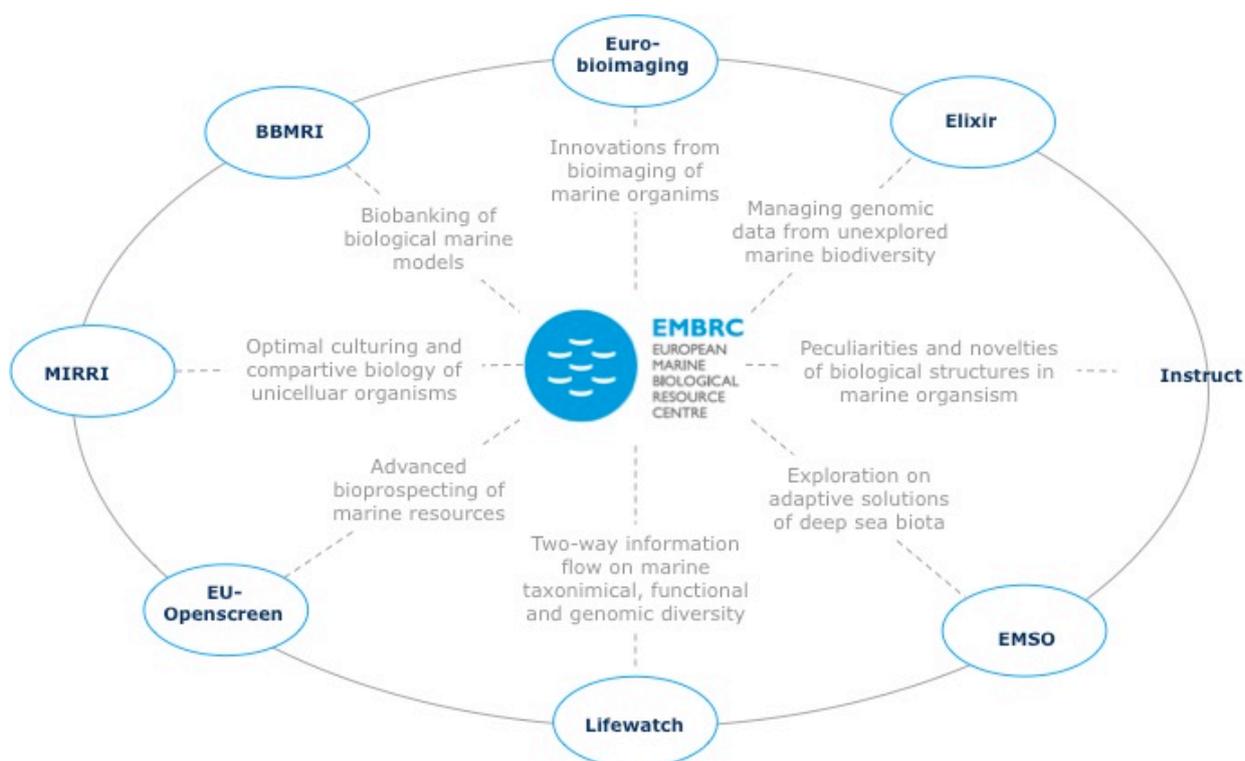
Identifying and promoting EMBRC resources: identify and catalogue all of the services provided by EMBRC, including competencies and data; identify good practices and implement them in all EMBRC nodes; monitor and record EMBRC outputs (papers, books, movies, videos, patents, training outputs - PhDs...); and measure the impact of the RI (based on KPIs related to the development of the infrastructure, user access, training, scientific impact, impact on industry, knowledge transfer and communication and marketing). EMBRC will launch an intensive programme of targeted promotion to attract users from academic research as well as industry. Activities will include participation in science and infrastructure conferences to promote services and opportunities offered by EMBRC, presence at relevant business and industry conventions to promote the use of marine expertise and bioresources through the infrastructure, and a number of Open-Days organized by the national nodes to showcase EMBRC facilities and demonstrate their range of uses.

Planning, constructing, operating and maintaining EMBRC e-Infrastructure: provide network access, information systems, storage capacity, computational resources, software and

human resources; ensure that EMBRC partners and external users have access to each of those components, to allow for research projects and to store, analyse and make publicly available the large volumes of data generated in the nodes. EMBRC will link the marine science community to the relevant data, analytical and e-infrastructure initiatives in Europe, such as ELIXIR and Sea-DataNet, avoiding duplication but adding marine-specific services and hardware as required. EMBRC is in on-going discussions with ELIXIR for a hybrid organizational model of service provision for the marine biological research community, i.e., between a centralized and evenly distributed facilities.

Coordinating relationships with EMBRC stakeholders, in Europe and abroad: negotiate alliances with national and European financial stakeholders, as well as with maritime regions (4.6); ensure EMBRC corporate representation in scientific meetings and Infrastructure conferences; engage with ERA-NETs and JPI-s in the marine and life sciences.

Collaborating with cognate RI's (figure 3): collaboration and coordination between European RIs in related fields will be essential to establish a strong community of service providers and research enablers, allowing them to speak with one shared and influential voice to policy makers and stakeholders; to foster a new era of research utilizing comprehensive RIs; to confront common problems and shared solutions; to develop common underpinning technologies, practices, protocols, standards, ontologies and collaborative projects; to share user communities and develop integrated, multi-RI service pipelines; to strengthen the connection of science with industry by federating technology transfer (TT) services, to exchange data between producer-RIs and custodian RIs (ELIXIR and LifeWatch).



**Figure 3: Relationships of EMBRC with other cognate Research Infrastructures**

### 3.2. Access to EMBRC facilities

The procedure for managing user access requests within EMBRC will be based on the successful model developed and refined during the ASSEMBLE project. Proposals for on-

site access will be solicited via a central web portal that will provide detailed information on services offered, eligibility criteria, terms and conditions of use and information on pricing. The units for on-site access to platforms, research and logistical services, experimental facilities and laboratory space (and associated assistance by expert staff) will be per-person-per-unit time (typically day or half-day). Remote access to biological resources and analytical services will be per-item (e.g. microbial strain, whole organism for multicellular organisms, samples for analyses).

Proposals involving academic research will be first screened for practical feasibility by in-house RI staff at the requested sites and subsequently evaluated and ranked by a largely external User Selection Panel (USP). Projects from private industry will be evaluated on the basis of feasibility. Projects from academics classified as feasible will be selected and ranked based on scientific/technological quality and originality, pertinence to EMBRC thematic priority areas, merit of the users, environmental impact/ethics, and innovation potential of the submitted proposals. The EMBRC Secretariat, assisted by access officers at the national nodes, will then validate ranked projects taking into account the access capacity of individual sites. Requests for remote services will undergo a streamlined process involving eligibility and feasibility checks. Access will be monitored, user satisfaction measured, and a feedback mechanism implemented as part of quality assurance for continuous improvement of access and services.

### **3.3. Joint development of Key Enabling Technologies**

With the objective of developing a top-level, world class infrastructure EMBRC will carry a high responsibility for the development of Key Enabling Technologies in the area of marine biology and ecology. Even though these activities depart from actual science programming, they will have a very high scientific impact on marine biological sciences, for the benefit of the whole community. Substantial added value of EMBRC will come through providing new opportunities for EMBRC partners and users to exchange know-how and expertise and to provide access to state of the art technology centers of excellence for the whole research community across Europe. The unique strength of EMBRC therefore lies in its provision of facilities and opportunities for research and training that no single country could provide alone.

Key technical challenges for EMBRC lie, for example, in the establishment of remote access, linking of virtual assets (e.g. data) between laboratories and RIs, and development of user-friendly service work-flows. A program of joint development activities (JDAs) will ensure organisation and strategic placement of future infrastructure services, in accordance with local expertise and specialisation strategies.

EMBRC will also foster JDAs with the community. A key area will be the development of biological resources to address specific user needs. The JDAs will be instrumental in integrating the research infrastructure offering high quality services to diverse user communities. Where appropriate, they will be conducted in close consultation with complementary RIs (e.g. ELIXIR<sup>4</sup>, MIRRI<sup>5</sup>, AquaExcel<sup>6</sup>, Lifewatch<sup>7</sup>, EU-Openscreen<sup>8</sup>) in order to cross-fertilize best practises and avoid unnecessary duplication of effort. The R&D program will focus on developing services to respond to scientific and biotechnological research priorities of academic, governmental and industrial users.

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<sup>4</sup> [www.elixir-europe.org](http://www.elixir-europe.org)

<sup>5</sup> [www.mirri.org](http://www.mirri.org)

<sup>6</sup> [www.aquaexcel.eu](http://www.aquaexcel.eu)

<sup>7</sup> [www.lifewatch.eu](http://www.lifewatch.eu)

<sup>8</sup> [www.eu-openscreen.eu](http://www.eu-openscreen.eu)

Key examples include:

- technological and methodological advances in the collection, long-term *ex situ* maintenance and transport of live unicellular and multicellular marine organisms and for development of laboratory facilities better able to simulate natural environments.
- co-ordination and development of genetic resources such as mutant collections and transgenic lines for flagship eukaryotic and prokaryotic model organisms;
- creation and consolidation of genetic resources such as selected or modified genotypes with enhanced performances for aquaculture (e.g. marker assisted selection) or for biotechnology (e.g. cell factories);
- fostering the broader application of 'omics', e-DNA and related methods for high throughput environmental biodiversity studies and functional exploration of marine models;
- development of new models with high ecological relevance along with associated research tools, and databases providing access to relevant genetic and ecological data.

### 3.4. Knowledge Transfer for Innovation

#### 3.4.1 Strengthen fundamental marine biological research

Fundamental research provides the key driver of innovation and the foundation on which new technology, food, and biomedical advances are built<sup>9</sup>. EMBRC will offer services and tools to explore new frontiers in biological science and to accelerate the pace of discovery in areas supporting priority sectors such as blue energy, aquaculture, bioremediation and marine resource management and blue biotechnology. As a research infrastructure, EMBRC will raise the profile and exposure of marine research, facilitating the up-take of new discoveries by providing a sound platform for disseminating relevant research outputs to the private sector but also to foster the original, sometimes unconventional, collaborations that lead to new products and technologies.

#### 3.4.2 Support to the development of blue biotechnology.

Marine biotechnology can be thought of as the use of marine bioresources as the target or source of biotechnological applications. This broad understanding of marine biotechnology thus includes both traditional forms of marine biotechnology like aquaculture and modern forms such as bioremediation, production of biofuels and genetic modification of fish<sup>10</sup>. Marine biotechnology is estimated to represent 2-5% of the EU bio-economic sector, leading to an annual turnover of 500 M€ and is expected to continue to grow rapidly in the next decade. In its recent analysis of the potential, hindrances and opportunities in this field, the OECD states:

*“Advances in genomics and computer science have transformed earlier views of the ocean. It is no longer simply a source of food, but a vast reservoir of genetic potential and a means of achieving a wide range of socio-economic benefits. Genome sequencing is no longer the barrier it was a decade ago and our understanding of marine bioresources has improved significantly. [However] new Infrastructures are needed, with new models, new culture systems and new bioinformatics-based approaches to visualize genomics and other types of data”<sup>11</sup>.*

<sup>9</sup> “Basic Research is the Key Driver of Innovation (2009) Gruss, P.  
[https://www.mpg.de/799746/W000\\_Viewpoint\\_006-009.pdf](https://www.mpg.de/799746/W000_Viewpoint_006-009.pdf)

<sup>10</sup> OECD (2015) - <http://www.oecd.org/sti/biotech/marinebiotechnologyattheoecd.htm>

<sup>11</sup> OECD (2013). Marine Biotechnology: Enabling Solutions for Oceans Productivity and Sustainability.

A recent study conducted by the European project *Atlantic Blue Tech*<sup>12</sup> also indicated that access to knowledge and technology is considered as a major barrier/driver of business development in the marine bioresource economic sector.

EMBRC will largely contribute to the expansion of these economic activities by providing key scientific services and infrastructure support to blue biotechnology, but also to other cross-cutting priority sectors of the Blue Growth Agenda (e.g. blue energy, aquaculture, ocean monitoring, control and surveillance). EMBRC will offer a delivery mechanism to EuroMarine, which places innovation and technology among its priorities. EMBRC will also serve and support relevant JPIs and related ERA-NETs, e.g. OCEANS<sup>13</sup> and MarineBiotech<sup>14</sup>, respectively.

EMBRC will directly contribute to the creation of increasing numbers of spin-off and start-up blue biotech companies. Examples already exist of a small number of start-up companies that have arisen from marine stations, e.g. Glycomar<sup>15</sup> in Oban, UK. EMBRC will also foster collaborations between academic marine biology institutes and enterprises that are already active in blue biotechnology or that are contemplating entering the sector to expand and/or diversify their operations, e.g. companies that exploit terrestrial plant resources and that wish to exploit seaweeds.

Private users will find in EMBRC a unique R&D portfolio, which can fulfil a variety of their company requirements. EMBRC will encourage the establishment of Science Parks at the EMBRC facilities, with the aim of promoting public-private collaborations and raising the Technology Readiness Level (TRL) of EMBRC generated knowledge and discoveries. The infrastructure will also foster transnational collaborations within the private sector.

#### 3.4.3 IP policy support.

EMBRC aims to adopt an IP Policy that is a reliable framework for the transfer of knowledge arising from the different services and activities provided by the infrastructure and an incentive to innovate. As a consequence, EMBRC will facilitate the negotiation between the nodes and the users and will leave them the responsibility to negotiate IP agreements according to the national statutory laws and the nodes' operator policies. However, EMBRC will provide specific guidance when appropriate, especially regarding the use of genetic material. To ensure coherence and uniformity in accessing bioresources in Europe, EMBRC will collaborate closely with other biological resource RIs in the biological and medical sciences, such as MIRRI, to develop common policies and confront shared problems in cooperation to find common solutions.

As a principle, all knowledge generated by EMBRC users in the form of intellectual property rights vest and belongs to the user, who has generated it. Yet, the contribution of EMBRC in the generation of such results should be acknowledged. EMBRC users will be encouraged to make their results, as well as the data, openly available. In addition, EMBRC and its nodes' operators may wish to promote other schemes more suitable when collaborating with industry. Finally, specific IP policies may be developed if EMBRC decides to partner with some industrial sectors to foster a given strategic innovative field.

EMBRC is following recent developments concerning the implementation of the Convention on Biological Diversity's (CBD) Nagoya Protocol for Access and Benefit Sharing for the use of biological resources that entered into force in Europe in 2014. This presents a potential

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<sup>12</sup> "Recommendations for entrepreneurs and public agencies from the Atlantic Blue Tech project - June 2015". [http://www.mitin-network.org/files/2323/Marine\\_bio\\_resources\\_press.pdf](http://www.mitin-network.org/files/2323/Marine_bio_resources_press.pdf)

<sup>13</sup> [www.jpi-oceans.eu](http://www.jpi-oceans.eu)

<sup>14</sup> [www.marinebiotech.eu](http://www.marinebiotech.eu)

<sup>15</sup> [www.glycomar.com](http://www.glycomar.com)

obstacle to users, whether public or private. EMBRC will offer guidelines and collections of biological material registered with the European Commission, ensuring that users accessing EMBRC resources have exercised “due diligence” as regards the seeking of all necessary information, greatly facilitating access to marine resources. Combined with expert support, best practices and guidelines EMBRC will become the focus for access to marine biological resources, setting high standards for traceability and ethical sourcing, and positioning itself globally as a broker for accessing marine bioresources between users and supplying countries. It will put into practice mechanisms for harmonized approaches to organism access and use in compliance with the new EU regulation on Nagoya protocol.

### **3.5 Education and training**

Teaching and training will be a core activity of EMBRC. Currently, offers for marine training in Europe are spread among hundreds of websites of different providers (universities, marine stations, etc.), making it difficult to identify users and organisers of marine training. In addition, there is a lack of training opportunities for administrative, technical and scientific staff.

EMBRC will explore these needs further and update and develop new trainings accordingly. In particular, EMBRC will be involved in the establishment of new training initiatives related to blue biotechnology through EMBRIC. This will ensure harmonisation of training offers between the involved RIs, organisations and industry. EMBRC-Belgium already has established “The European Marine Training Portal”<sup>16</sup>. The training portal provides an overview of marine training opportunities in Europe through a single, easily searchable interface.

Finally EMBRC will seek to provide training for the users of its facilities and its staff including facility and data managers, technical and scientific staff. It will build on the large existing offer of marine training at its nodes, including by staff exchange. Funding opportunities such as Innovative Training Networks (ITN), Research and Innovation Staff Exchange (RISE) or Co-funding regional, national and international programs (COFUND) will be explored and promoted into the EMBRC community for common implementation between the Infrastructure and its users.

### **3.6 Allying with peripheral maritime regions**

By essence, EMBRC laboratories are located in peripheral maritime regions, often far from the major knowledge centres. Typically, marine stations are also geographically separated from major concentrations of industry and located in areas with declining maritime activities (e.g. fisheries, ship-building) and unemployment rates above the European average. In their Smart Specialization Strategies, several maritime regions in Europe now fully recognize the potential of blue technologies and bio-economy to mitigate these problems and thereby catch up with socio-economic mainstreams. They are considering the idea that supporting RI excellence at the pan-European level will improve funding efficiency and benchmarking capacity, as well as providing higher visibility and attractiveness, including towards private research.

The principle of partnering with EMBRC was approved by the Conference of Peripheral Maritime Regions (CPMR Board meeting, Inverness, June 6<sup>th</sup> 2014), which considers this RI as a major partner for the development of blue technologies and the promotion of their maritime economies. A top priority of EMBRC will therefore consist in connecting with CPMR members and ensuring that the RI is well integrated in their ESIF Operational Programmes. EMBRC will work not only with those regions which harbour (and often sustain) EMBRC

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<sup>16</sup> [www.marinetraining.eu](http://www.marinetraining.eu)

laboratories but also with other maritime regions which lack high level infrastructure to support their blue bio-economy and encourage collaboration and synergies, rather than unnecessary competitiveness, between regions with similar economic interests. Integrating EMBRC at the local level, increases the socio-economic impact of the RI by becoming as corner stone of local economies, but also improves the long-term financial sustainability of EMBRC by increasing available funding to the RI.

## **4- Compliance with ERIC requirements**

### **4.1. EMBRC will increase Europe competitiveness and visibility in the creation of knowledge and innovation**

The distribution nature of EMBRC will encompass the whole of Europe regional seas, providing a more complete coverage of ecosystems and biological resources. This completeness will broaden access to European marine biodiversity, accelerating the rate of discovery in life sciences and the application of these discoveries. This will also bring a high bonus in many areas of the European environmental policy, including, for example, the refinement of ecosystems monitoring (cf the « genomics observatories » for the Water and Marine Strategy Framework Directive).

Significantly also EMBRC will help to reinforce and solidify Europe as leader in marine biology and the exploitation of marine resources. The European model of seashore laboratories with a critical mass of scientists for the investigation of marine life in all of its multiple facets was not entirely transposed to other parts of the world, in particular into those countries where major universities are located nearby the sea (e.g., Brazil, China and Japan). Interestingly, however, several countries as different in size as Uruguay and India recognize the value of European marine stations and have approached EMBRC for collaboration in the establishment of centres of excellence in marine biology.

Marine bioresources are becoming a highly strategic field world-wide, in particular for fast-developing economic powers such as China, Brazil, India, as well as for established blocks such as USA, Canada and Japan. Individual marine stations in Europe are already facing strong international competition and new opportunities in scientific research, higher education and innovation in marine biology and ecology. Internationalisation issues in these areas today are handled individually by the marine stations and their operators, resulting in a variety of multiple, non-concerted initiatives. In the long term, this sub-optimal strategy will not be sufficient and will weaken European leadership in marine biological research. EMBRC will claim both representation and leadership at the EU level, an evolution which will deliver well-served global positioning of Europe in both fundamental and strategic research, and higher education in marine biology and ecology. In a similar vein, EMBRC will be strategically important in negotiating access and legal clearance to marine bioresources of these developing countries, and other biodiversity-rich regions.

### **4.2. EMBRC will increase integrating and leveraging of national, regional and European investments**

#### **4.2.1. National investments**

At the level of national nodes integration by EMBRC will bring more comprehensive science coverage, more permanency and efficiency to develop key enabling technologies, as well as benchmarking with the other nodes. Hence, the added value of EMBRC at the national level will first consist in increasing the efficiency of its major national marine laboratories, with a better coordination of investments. This will result in more foresight for strategic priorities and

global development as well as better networking and building of critical mass and competitiveness, leading to more industrial leadership and innovation in SMEs.

#### **4.2.2. Regional investments**

At the regional level, pan-European and international use of EMBRC marine stations and laboratories will result in higher visibility for the regional nodes, including by promoting decentralized cooperation within EMBRC as well as with non-EMBRC regions. This will act as a catalyst to attract companies and investment to these regions.

EMBRC will also act as a focal point of knowledge, innovation and exchange of information for SMEs that will benefit in particular the less developed regions, reducing inequalities, promoting employment and increasing European societal cohesion. This will be achieved by embedding EMBRC laboratories in their respective regional research driven clusters and identifying common incentives between these innovation ecosystems to overcome any regional tendencies for isolation and to build on complementarities and synergies. These actions will contribute to integrating European peripheral maritime regions into the mainstream of scientific knowledge and economic development.

#### **4.2.3. European investments**

Based on its pan-European dimension, EMBRC will have the capacity to analyse, at regular intervals, the evolution of science needs, to monitor and inventorise the efficiency of the portfolio of services offered by EMBRC (KPI metrics) and to guide propositions for new instrumentation and new construction. This will progressively result in a “smart specialization” of the EMBRC facilities leading to more subsidiarity in the Infrastructure and a better general service for the user community.

As the only marine RI in biological and medical sciences as well as the only RI in biology for marine sciences, EMBRC will rapidly become a focal point in the implementation of the regional, national (e.g., the JPI Oceans) and European policies (Blue Growth and Regional S3s) in marine biology and ecology. Since the implementation of these policies will largely depend on access to EMBRC nodes, the Infrastructure will rapidly become a privileged interlocutor to a variety of European networks, such as the Marine Biotech ERA-Net and Euromarine.

### **4.3. EMBRC will provide effective access to member states and associated countries**

Historically, marine stations were opened for users from all over Europe. They have, however, not kept accurate records of the numbers of external users. In the FP7 project ASSEMBLE transnational (TNA) program, 8 partners hosted 618 on-site access projects over 4.5 years (17 projects/site/year) with an average of 2 users/project and an average duration of 2 weeks/project (range of 1-8 weeks). For remote access, ASSEMBLE offered access to culture collections to 78 users in total (20 users/year) with an average of 8 strains/user.

The ambition of EMBRC will be to engage a wider community of users to perform beyond the indicators above, better serve the public and private research communities, and the economy. Specific measures will hence be taken to increase the openness and visibility of the infrastructure as well as to attract private-sector users. They include: (i) seeking of funding mechanisms to alleviate the cost of access for such users as young researchers and SMEs; (ii) promote the use of marine models in fundamental and applied research beyond traditional user groups to demonstrate their use and applicability in a wide range of sectors (e.g. biomedical, pharmaceutical, evolution and development, biotechnology, ) (iii) promotion of EMBRC towards maritime regions, including those regions with no EMBRC facilities, and towards countries with no access to the sea; and, (iv) establishment of formal links with

similar Infrastructure organizations abroad Europe. Anticipating success in attracting new communities, the development of the maritime bio-economy in Europe, and the growing interest of third countries for EMBRC, we estimate that the numbers of users can be doubled in the first years of operation.

#### **4.4. EMBRC will increase the mobility of knowledge**

EMBRC occupies a pivotal position between biological sciences, bio-medical sciences and agronomical, ecological and environmental sciences. Embedded in the “Health and Food” ESFRI group, the infrastructure is rooted in the fast-moving conceptual and technological development of modern biology, to which it brings access to the entire tree of life. It also is the only biological RI in marine sciences, where the EMBRC community is contributing new knowledge in biological oceanography, ecosystem functioning, chemical ecology as well as bio-geochemistry. EMBRC will serve as a cradle to increase the mobility of knowledge across those disciplines and foster new, multidisciplinary initiatives.

EMBRC will also promote the dissemination of knowledge through a programme of courses, schools and workshops. Activities will be customized for its variety of users, including public research, the private sector and policy-makers. Altogether, this will promote the mobility of knowledge across the whole range of EMBRC stakeholders. In particular allying the Infrastructure with CPMR will widen the user community and extend its visibility by local, smaller companies in the maritime regions.

#### **4.5. EMBRC will increase the dissemination and optimization of research**

As an infrastructure comprehensively distributed along the European coastline, EMBRC will optimize the delivery of excellent science and technology for basic, fundamental research throughout Europe. The technologies for exploiting the potential of marine bio-resources are now sufficiently mature for direct application to a wide range of economic sectors. EMBRC will provide knowledge transfer services (KTS) as one of its core activities. These services will be based on the methodology developed in the Coordination and Support Actions (CSAs) “Marine Genomics for Users” (MG4U) and “Columbus”. The primary goal of the activity of KTS will be to raise awareness within academia, industry, and governments of the outputs and potential applications of knowledge from marine biological research conducted using EMBRC facilities. Knowledge outputs will be assessed for their relevance to the various sectors of the blue bio-economy, such as blue biotechnology, aquaculture, and drug discovery.

Technology Transfer Services (TTS) will be organized on the local scale, at the level of EMBRC regional facilities. A primary goal of these local innovation ecosystems is to increase their Technology Readiness Level (TRL) whilst retaining IPR locally, increasing the chances that opportunity and profit remain in the region of discovery. The Infradev-4 project EMBRIC will serve as a pilot project to create a European network of TTS around marine bioresources. The objectives of EMBRIC are to: (1) Develop integrated workflows of high quality services for access to biological, analytical and data resources, by connecting cognate biological and social science research infrastructures, namely EMBRC, MIRRI, EU-OPENSREEN, ELIXIR, AQUAEXCEL and RISIS<sup>17</sup>, and deploying common underpinning technologies and practices; (2) Strengthen the connection of science with industry by

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<sup>17</sup> [www.risis.eu](http://www.risis.eu)

federating technology transfer (TT) services; (3) Defragment RDI policies and involve maritime regions with the construction of EMBRIC.

EMBRC will improve the efficiency of translation of knowledge and mining of marine diversity for fields such as aquaculture, biotechnology, biomedicine, products, processes, and bioremediation, leading to a more competitive knowledge-based economy in the marine bioresource sector. Marine genomics knowledge also has enormous potential to assist organizations involved in governance and sustainable management of the marine environment and its resources. Altogether EMBRC will help building synergies for a more circular and sustainable economy in the utilisation of marine bioresources.

## 5. Conclusion

Working across the scientific, industrial and socio-economic dimensions of marine biology and ecology EMBRC will fill an important niche in the ERA. In particular, EMBRC will be instrumental to explore, elucidate and exploit the wealth of marine bio-resources, from gene discovery and molecular farming to the production of whole organisms. The Infrastructure will become a focal point for the coordinated implementation of regional, national and European policies on blue bio-economy. A variety of public and private stakeholders (regional, national, European or international) will have the opportunity of using EMBRC as a key partner, capable of servicing stakeholder needs and policies at all scales. This will enhance the alignment of Research and Innovation as well as the Cohesion policies of Europe in the domain of marine bio-resources and good environmental status.

To summarize concisely the aim and objectives presented in this description, EMBRC will:

- (i) promote and advance marine biological science and its potential use and contribution to industry and society;
- (ii) develop new tools and methodologies to enable innovative research in the field and deploy new technologies to enable new discoveries;
- (iii) provide access, advice and guidance on the use of marine bioresources and play an active role in access clearance to marine biodiversity for the user community;
- (iv) raise the level of investment in infrastructure and human capital, with the aim of attracting and retaining in EMBRC the best researchers and staff from within Europe as well as from third countries;
- (v) contribute to the coherence and cohesion of the research policies in marine biology across Europe, resulting in a higher and better integrated critical mass at the infrastructure level and with a common understanding of strategic orientations; and,
- (vi) establish formal relationships with regional, national and European policy-makers and provide a clearly identified voice which will defend the strategic, long-term interests of Europe in marine biology.

In conclusion, the establishment of EMBRC will integrate and increase the capacity of European research in marine biology and ecology, two rapidly growing science fields. It will provide effective open access to users, particularly researchers and students, fostering the mobility of knowledge and of human capital throughout Europe. It will consolidate the links between science and industry on the one hand and between the maritime regions on the other hand, promoting the knowledge-based blue bio-economy. Altogether EMBRC will be a unique instrument to support the two Blue Growth pillars, marine knowledge & marine biotechnology.

All of this will be a major step forward, which *“is necessary for the carrying out of European research programmes and projects, including for the efficient execution of the Community research, technological development and demonstration programme”* (Article 4 of ERIC

regulations). EMBRC will also contribute to structuring the ERA, within its own specific field but also by linking to other cognate research infrastructures, particularly in biological and biomedical sciences as well as in environmental sciences. It will improve European visibility and global positioning, by improving competitiveness in education, science and innovation, and by organizing long-term, structuring collaborations with strategic third countries abroad. All of this represents “*an added value in the strengthening and structuring of the European Research Area and a significant improvement in [EMBRC] scientific and technological field at international level*”.

## 6. Key Performance Indicators for the first three years

Indicator	Target
<b>A. Development of EMBRC</b>	
1. Number of European and associated countries participating in the infrastructure	Increase number of ERIC signatories by 2 countries by the end of year 3
2. Diversity & complementarity of high quality services: coverage of workflows (pipelines)	Increase number of completed workflows by 5 by year 3
3. Number of new marine research platforms in EMBRC	Increase number by 5 platforms by year 3
4. Participation in European and international projects	Year 1: 3 projects; Year 2: +2 projects; Year 3: 5 projects total
5. Number of collaborations with third countries	Increase number of third countries, outside of Europe by 2 countries
<b>B. User Access to EMBRC</b>	
1. Number of user access requests	200 proposals in year 1; 400 proposals in year 2; 800 proposals in year 3
2. Number of accepted users	100 users in year 1; 200 users in year 2; 300 users in year 3
3. Number of users from outside core-marine biological community (user community diversification)	Year 1: 5% of total access requests; Year 2: 10% of requests ; Year 3: 15% of requests
4. Quality index (is the quality of your services as high as your users are expecting?)	Number of return users per year
5. Number of service contract	
<b>C. Financial Indicators</b>	
1. Monetary value of European and international projects	
2. Monetary value of offered access	Year 1: Year 2: Year 3:
3. Number of user access contracts funded by non-EMBRC lead access programmes (i.e. H2020, MSCA, national funding agency grants)	Year 1: 10% of total access requests; Year 2: 20% of requests; Year 3: 40% of requests
4. Access Cost Variance (are visits coming in without going over budget?)	
<b>D. Training &amp; Education Indicators</b>	
1. Growth of training/course/education on the European Marine Training Portal (base-line: 76 courses)	Year 1: +15 courses; Year 2: +35 courses; Year 3: +65 courses
2. Growth of usage of European Marine Training Portal	Increase number of visits to the online portal by 100% per annum
3. Number of users of EMBRC-lead training courses	Year 1: 25; Year 2: 40; Year 3: 40
4. Number of staff training exchanges (exchange of good practice)	Year 1: 10 exchanges; Year 2: 20 exchanges; Year 3: 25 exchanges
<b>E. Scientific and Technological Indicators</b>	

1. Number of scientific events organised by EMBRC & participation (conferences/workshops)	20 per annum
2. Number of joint development activities	Year 1: 1 JDA; Year 2: 3 JDAs; Year 3: 5 JDAs
3. Number of publications, patents, IPRs or products citing EMBRC DOIs (e.g. methodologies, techniques, standards, procedures, metadata, instruments)	Year 1: 25; Year 2: 75; Year 3: 100 (Year 4+: 300+ per annum)
<b>F. Impact on Industry Indicators</b>	
1. Percentage of users coming from industry	Year 1: 5% of users from industry; Year 2: 10%; Year 3: 15%
2. Number of regional R&D networks in which EMBRC participates	Year 1: 5 networks; Year 2: 10 networks; Year 3: 20 networks
3. Number of EMBRC R&D collaborations with industry	Year 1: 5 projects; Year 2: 10 projects; Year 3: 20 projects
4. Number of industrial contracts with EMBRC	Year 1: 5 contracts; Year 2: 10 contracts; Year 3: 15 contracts
<b>G. Influence on Society at Large</b>	
1. Participation of EMBRC in policy panels and forums	Year 1: 2; Year 2: 5; Year 3: 10
2. Internet hits (Google, social networks)	Year 1: 20% increase from launch of operations; Year 2: 50% increase; Year 3: 100% increase
3. Number of public engagement events	
<b>H. Communication &amp; Marketing Indicators</b>	
1. Number of newsletter subscribers	Year 1 : 800; Year 2 : 1500; Year 3 : 2300
2. Number of open-days organised per user group (industry & academia)	10 events per annum
3. Number of events participated in by EMBRC (not organised by EMBRC, e.g. trade fairs)	Year 1 : 5 ; Year 2 : 10; Year 3 : 12
<b>I. Knowledge Transfer Indicators</b>	
1. Number of knowledge portfolios lodged in KT platform	
2. Knowledge Outputs (advisory services)	
3. Knowledge requests from KTT platform	
4. Policy Actions (e.g. working groups, recommendation Reports, foresight studies)	

## 7. EMBRC Risk assessment

The nascent EMBRC faces a series of internal and external *risks* at various levels of its organization, and in various phases of its maturation. Here, we identify the most important risks, and list actions to mitigate them.

### 1. Risks that could delay the project, increase costs of or make realisation of the infrastructure tasks impossible

As a distributed RI uniting existing marine research institutes across Europe, EMBRC faces key operational *challenges* and may also be threatened by technical *risks* on both consortium and national/institute level. Risk of malfunction, problems and issues affecting the consortium

adversely may occur in preparing the ERIC, during the operational phase, on consortium level as well as within each/a few national nodes(members).

Improvements regarding basic instrumentation and access to ecosystems are to be conducted at all partner institutes and marine stations. The probability that a significant proportion of member states fail to invest at their respective expected level is assessed (very) low, and there are no major technical risks representing an immediate threat of failure for EMBRC as a whole. Since the last ESFRI evaluation (March 2013), several of the initiating member countries have engaged or planned major investments to enhance and strengthen their respective nodes, giving access to a comprehensive range of unique ecosystems, facilities and services. Regarding the provision of other services, knowledge and know-how, EMBRC will explore the capacity to progressively engage into a smart specialization strategy.

However, there are risks primarily connected to the implementation of EMBRC throughout the member community. These may include failure at the member country level to decide on formal affiliation to EMBRC, unsuccessful recruiting of key staff and insufficient funding of the core and nodal activities (both at host and regular member levels).

Even though most risks are assessed to be of lesser severity and/or affecting only partially the EMBRC (i.e towards one or few countries/institutes at the same time), they need to be addressed properly in the implementation and operations phases.

## **2. Main scheduled uncertainties/risks**

We aim at submitting the EMBRC Step 1 (draft) proposal to the Commission by summer/early autumn 2015. This objective is attainable provided that:

- i) consensual agreement is achieved on the role of the ERIC and on its relationships with the distributed nodes,
- ii) perimeters of the EMBRC national nodes are well stabilized, and
- iii) a significant proportion of EMBRC members define the level(s) of their potential financial contributions to early activities of EMBRC.

During the Implementation phase the following items are identified as main obstacles to a successful entering into the Operational phase as an ERIC:

- 1.) Lack of staffing of the core office – may lead to failure in running the project according to set plans, of funding the project continuously etc
- 2.) Insufficient resources earmarked at the node (on national and institutional) levels – leads to incoherence and mismanagement
- 3.) Lack of project management – leads to non-compliance with expected progress towards EU and regulatory requirements on national level
- 4.) Office management (archiving, communications, dissemination, visibility, website etc)
- 5.) Risks are also connected to the finalizing of the application documents, but the length of the preparatory phase and the established mutual understanding and respect among the participants has - till now – demonstrated that as a risk *per se* this is insignificant.

Services and access opportunities will be offered to the scientific community and relevant stakeholders/user groups already in this phase. This gives the consortium an excellent opportunity to test at an early stage the coherence and communication between core office and the node level, to see whether the single-entry/-access point is a viable model and if the EMBRC services/access entries are attractive to the potential user community at large.

Submission of the Step 2 (proper) EMBRC application will mostly depend on the reactivity of the different EMBRC members in committing sufficient, sustainable resources to the infrastructure and delivering the needed approval of national membership. The intimate communication/continuous discussion with Commission representatives, and the “ERIC experience” at the host, makes it reasonable to expect that the application in itself is not a major risk at this stage.

In particular, difficult and time-consuming negotiations within each member country (at government level) may constitute a serious risk that is difficult for the EMBRC consortium to remedy. There on the governance (e.g. links between level of commitment and voting rights) might delay the construction of EMBRC.

### 3. Risk Management/assessment and Quality Assurance System

An important lesson from EMBRCpp is that the Risk Management system should be comparably simplified: Risk management must be a means to ensure the proper project progress, and not become an aim in itself.

In the EMBRC preparatory phase a coherent risk management and quality assurance system was established, intended (by being scalable/flexible) to be operable also in the succeeding phases of the consortium. Risks were identified and gathered in a comprehensive Risk Register. Together with a Gantt Chart visualizing inter-connectivity between work packages, deliveries and milestones this is the major components of the EMBRC RM&QA System.

A regular assessment and reporting on identified risks control measures by an appointed Risk and Audit Committee that reports to the management team (i.e now the Core Office).

Transparency ensured through written Standard operating Procedures, the Risk Register and a Quality Assurance Protocol.

The Risk Register:

ID no.	Risks categories and sub-risks	Risk owner	Probability	Severity	Mitigating action(s)	Status	Comments
1	Role of ERIC not agreed						
1.1							
2	Relations between Core Office and nodes not agreed						
3	Unstable national nodes						
	Unresponsive operators						
4	Insufficient staffing of Core Office						
5	Insufficient resources assigned on node level						
6	Lack of project management						
7	Insufficient daily office management						
8	Delay in finalizing the ERIC proposal						(related to the impl. phase)
9	Competition from other RIs and other international consortia						

