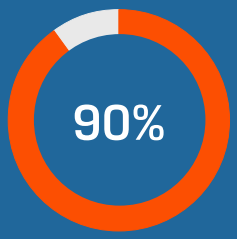
JPI OCEANS

Strategic Research and Innovation Agenda 2015-2020

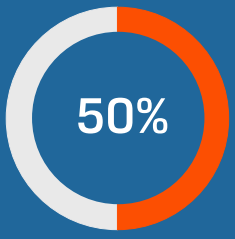
The Ocean

Contains



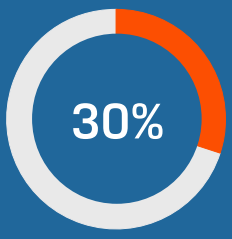
of the mobile carbon on Earth

Generates



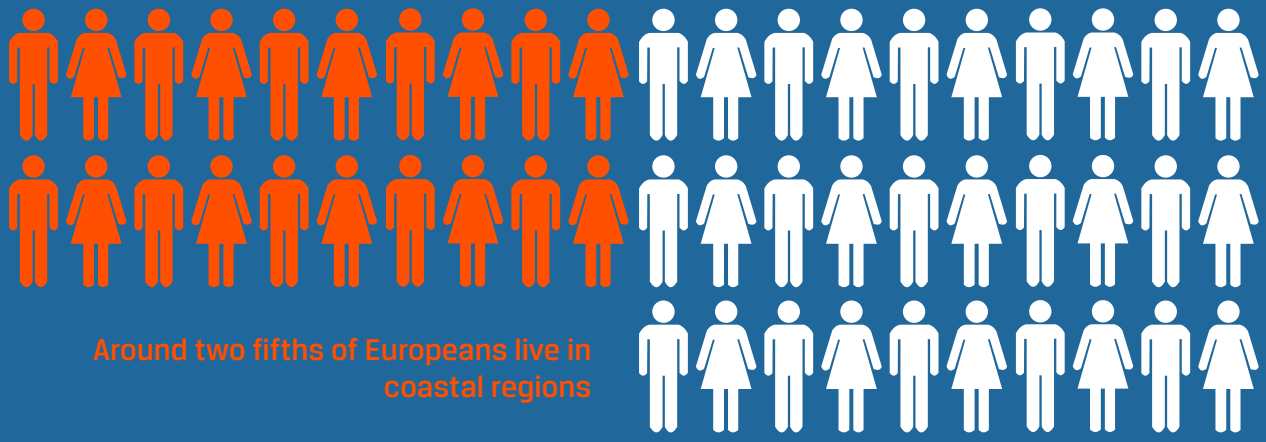
of the oxygen we breath

Absorbs



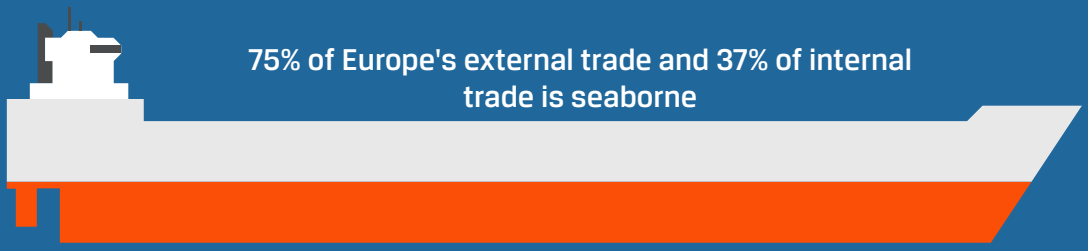
of carbon dioxide emissions

The European Maritime Territory



Around two fifths of Europeans live in coastal regions

Growth and Jobs



75% of Europe's external trade and 37% of internal trade is seaborne

List of Acronyms

CSA Oceans- A Framework Programme 7 funded Coordination and Support Action to support JPI Oceans in its start-up phase

ExCom- Executive Committee of JPI Oceans

GPC- The High Level Group for Joint Programming

IPlan- Implementation Plan

JPI- Joint Programming Initiative

JPI Oceans- Joint Programming Initiative for Healthy and Productive Seas and Oceans

MB- Management Board of JPI Oceans

SRIA- Strategic Research and Innovation Agenda

StAB- Strategic Advisory Board

Suggested Reference

JPI Oceans (2015) Strategic Research and Innovation Agenda. Joint Programming Initiative Healthy and Productive Seas and Oceans, Brussels.

Table of Contents

Strategic Research and Innovation Agenda

CHAPTER 1

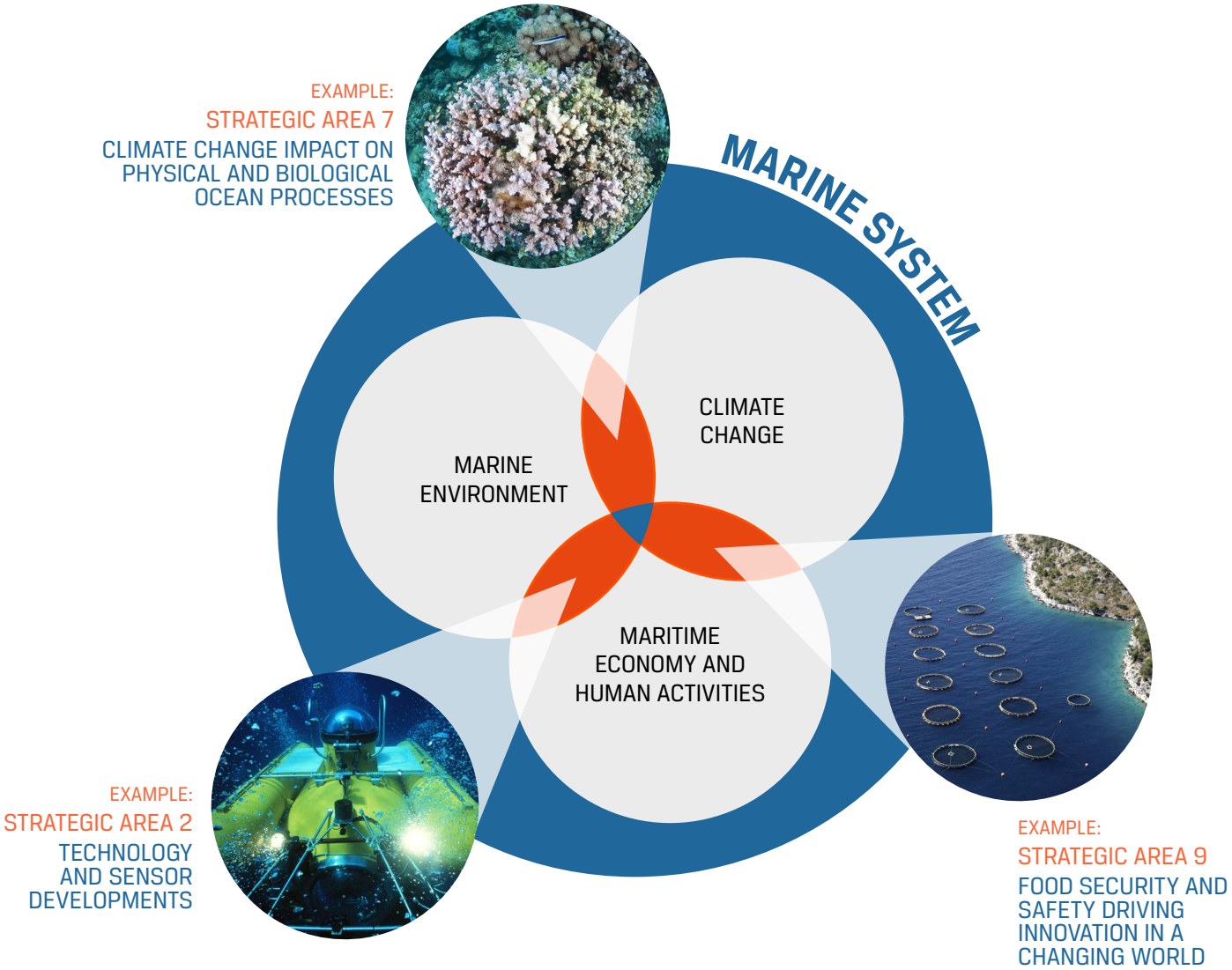
Introduction

Vision

The vision of the Joint Programming Initiative Healthy and Productive Seas and Oceans (JPI Oceans) is to enable Blue Growth and jobs, whilst fostering the health and productivity of seas and oceans and addressing the pressures of climate change and human impacts on the oceans.

Europe must realise the potential of its seas and oceans as a major contribution to the EU 2020 strategy and Blue Growth agenda, while addressing the challenges they face. It must ensure the sustainability and growth of the knowledge based marine and maritime economy whilst mitigating human impacts on the marine environment and coastal areas. Blue Growth requires an integrated knowledge base with concerted efforts in research and innovation; this knowledge needs to be translated into policies and useful products and services. At the same time there is a need to ensure Good Environmental Status of the seas, and optimise the planning of activities in the marine space. This must be set in the wider context of understanding the oceans' role in the earth system and optimising the response to climate change.

An important role of JPI Oceans will be to advocate the importance of the seas and oceans to the economy and society. It will support the development of effective policies with robust and independent scientific evidence.



JPI Oceans will focus its activities in the intersections between three areas: the marine environment, climate change, and maritime economy and human activities. It will also address transversal issues of ocean observation, data and infrastructure, cross cutting technologies and human capacities .

The JPI Oceans Strategic Mission

The JPI Oceans' mission is to act as a strategic platform to provide a long-term approach to marine and maritime research and technology development in Europe. By aligning national priorities and through the implementation of joint actions, JPI Oceans will add to the value and impact of national research and innovation investments.

What is Joint Programming and Variable Geometry?

Joint programming is a concept introduced by the European Commission in July 2008 which aims to implement the European Research Area (ERA). Joint Programming Initiatives are created to tackle Grand Societal Challenges that cannot be solved solely on the national level. They are based on the principle of variable geometry which allows Member States and Associated Countries to participate in joint initiatives most relevant to their national priorities.

The main objective is to increase the value of relevant national and EU R&D and infrastructure investments by concerted and joint planning, implementation and evaluation of national research programmes. Member Countries are expected to coordinate national research activities in the broadest sense, group resources, benefit from complementarities, and develop common research and innovation agendas.

The JPI Oceans Approach

Why is JPI Oceans needed?

The Grand Challenges of the oceans cannot be solved by a single country. Due the to interconnected nature of the marine environment, climate change and the maritime economy, an integrated approach to research and monitoring is required.

Who is involved in JPI Oceans?

The initiative is open to all EU Member States and Associated Countries who invest in marine and maritime research. With 20 marine Member Countries, JPI Oceans currently covers all European sea basins.

How will JPI Oceans act?

JPI Oceans will respond to the challenges of the oceans by reducing fragmentation and unnecessary duplication, planning common and flexible initiatives, undertaking horizon scanning and establishing efficient mechanisms and fit for purpose tools. JPI Oceans will continue to collaborate with the European Commission by aligning national research activities with EU funding instruments, such as Horizon 2020 and Structural Funds. JPI Oceans can also add value by addressing bottlenecks and barriers which are not taken up in the EU Framework Programme and other ERA tools.

Participation in JPI Oceans activities is based on the principle of variable geometry. To be considered as a JPI Oceans action, at least four Member Countries need to commit to involvement.

Many Grand Challenges of the oceans require cooperation beyond Europe. JPI Oceans can provide an interface between European and international activities at global and regional levels, such as the Transatlantic Ocean Research Alliance and the Blue Growth Initiative for the Mediterranean Sea.

The JPI Oceans role in transforming the research and innovation landscape

JPI Oceans can further align the marine and maritime European research and innovation landscape and ensure impact by:

- Engaging users and producers of knowledge in the design phase of actions to ensure relevance and uptake;
- Reducing the time from conception to realisation of calls and test innovative and efficient ways to address urgencies and emerging issues;
- Facilitating long-term actions which sustain critical mass to address Societal Challenges;
- Embedding PhDs in areas where there is a capacity need;
- Ensuring a flexible and adaptive approach to the implementation of actions to guarantee ongoing relevance.

When designing actions and identifying fit for purpose tools, JPI Oceans will add value and cost savings in marine and maritime sciences as well as promoting Blue Growth by:

- Further connecting research, private sector and technology communities;
- Fostering the development of an oceans engineering community to address cross-sectoral and enabling technology needs and contributing to the development of

clusters;

- Supporting a knowledge based marine spatial planning process which sets stable framework conditions for industries and other users;

- Strengthening observation and monitoring capacities through enabling technologies, new platforms and sensors; addressing under-sampling and ensuring that new environmental parameters can be rapidly and accurately measured.

European countries currently operate some of the most up to date research infrastructures but these are generally planned, operated and compartmentalised at the national level, limiting the potential uses of data. In addition, Member States' investments in data gathering for monitoring are increasing to respond to new policy needs and societal issues. JPI Oceans, being pan-European, can add value by:

- Developing a societally driven monitoring strategy, which will further harmonise data requirements and allow Member Countries to identify the appropriate infrastructures;

- Advocating open access to data and information;

- Strengthen cooperation on data gathering and sharing and ensuring greater use of e-infrastructures;

- Aligning requirements and procedures for data gathering, analysis and routine marine monitoring programmes and identifying possibilities for multiple uses across science disciplines, policies and industry;

- Raising awareness and exchanging practice on funding models for data acquisition in the transition from research towards long-term monitoring programmes;

- Advancing the use of predictive tools, models and simulations as observations alone are too expensive.

The activities to be undertaken by JPI Oceans can be categorised into three types of measures needed to transform the research and innovation landscape. These actions will continuously be assessed at the governance and the individual project level.

JPI OCEANS POLICY MEASURES

Policy measures are aimed at facilitating alignment and coordination at the level of Member Countries. These are the strategic processes of engagement, horizon scanning and information exchange between Member Countries and stakeholders that identify shared priorities and lay the foundations necessary to initiate structuring measures or Pilot Actions. They may also constitute independent actions for coordination and alignment at an intergovernmental level.

JPI OCEANS STRUCTURING MEASURES

Structuring measures are the specific activities to achieve the objectives of JPI Oceans' actions. Structuring measures will also address emerging research areas by bringing the users and producers of knowledge together, address gaps and fragmentation, share best practices and take actions to create an appropriate research and innovation landscape in Europe.

JPI OCEANS PILOT ACTIONS

Pilot Actions provide a method to test experimental ERA tools on a smaller scale before possibly entering into full implementation. They have emerged as a way for JPI Oceans to launch activities early and to demonstrate the benefits of different types of joint actions within the framework of JPI Oceans.

CHAPTER 2

Strategic Areas

This SRIA presents ten Strategic Areas, developed and agreed through an extensive consultation process (see annex II Overview of the consultation process). Actions within the Strategic Areas will vary in size, scope and duration. Specific actions in the cross-cutting fields of research infrastructures, science-policy interactions, and human capacities are also identified as being necessary to address the overall vision.

The 10 strategic areas are:

1. Exploring Deep Sea Resources
2. Technology and Sensor Developments
3. Science Support to Coastal and Maritime Planning and Management
4. Linking Oceans, Human Health and Wellbeing
5. Interdisciplinary Research for Good Environmental Status
6. Observing, Modelling and Predicting Oceans State and Processes
7. Climate Change Impact on Physical and Biological Ocean Processes
8. Effects of Ocean Acidification on Marine Ecosystems
9. Food Security and Safety Driving Innovation in a Changing World
10. Use of Marine Biological Resources through Development and Application of Biotechnology

1. Exploring Deep Sea Resources

© Picture Credit: ROV KIEL 6000 working on the Seafloor ROV-Team, GEOMAR Helmholtz Centre for Ocean Research Kiel

Rationale

It is becoming more feasible to exploit deep-sea resources as a result of technological developments and economic conditions. Deep-sea mining is identified as one of the five areas of high potential in the European Commission's Blue Growth strategy.

Deep-sea ecosystems are some of the most fragile and little understood on Earth. As a result, the knowledge needed to ensure a sustainable exploration and exploitation and to build appropriate policy frameworks is scarce. In particular, only limited areas of the seafloor have been mapped at a resolution sufficient to undertake meaningful resource assessments or exploration scenarios.

A coherent and long-term research effort is needed to support evidence based governance of the deep-sea biological, mineral and energy resources. This should also include scientific input to technological developments to ensure sustainable exploration and exploitation (see also Strategic Area 2: Technology and Sensors Development).

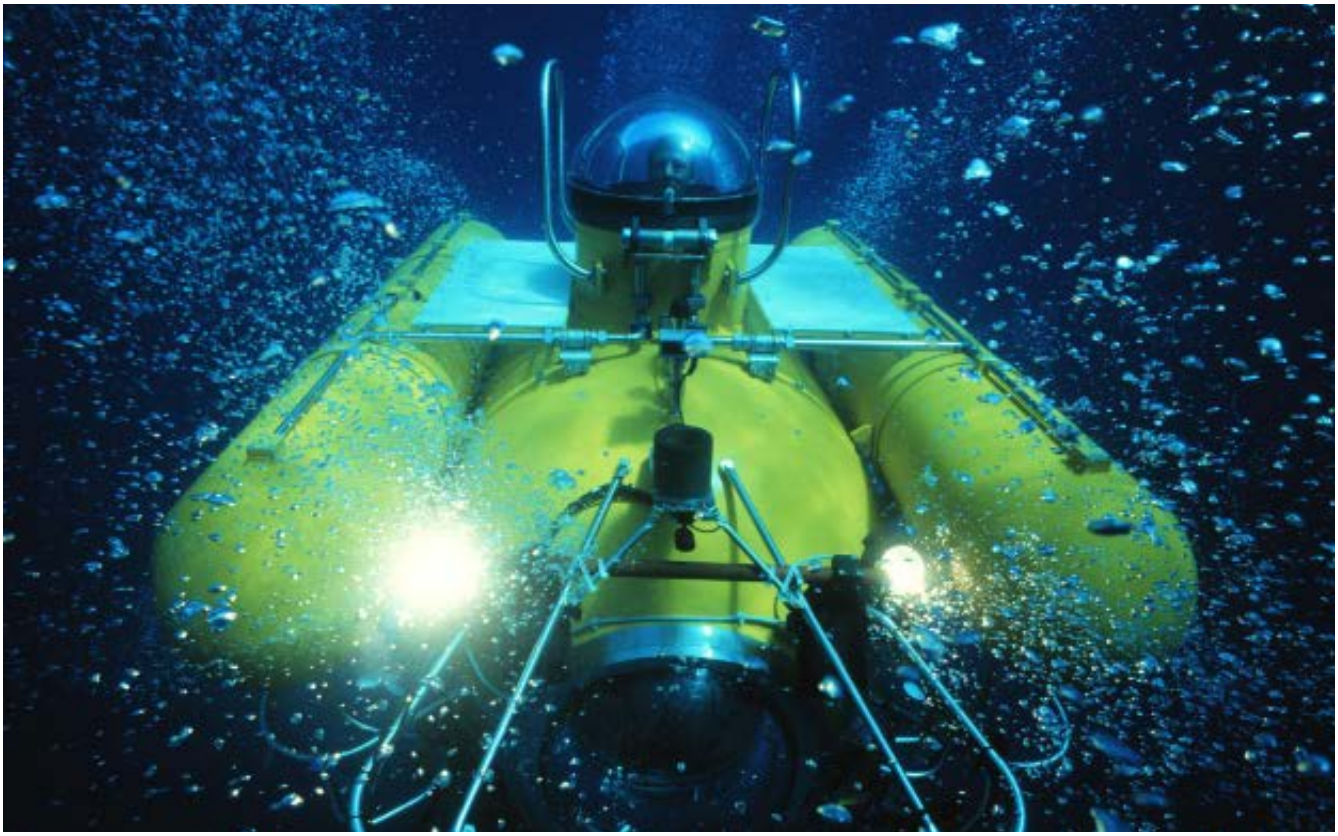
Activities

- Coordinate efforts to undertake a high resolution, multi-beam survey and habitat distribution and develop fit for purpose equipment for the deep-sea.
- The mapping effort will be combined with research on deep-sea ecosystems and habitats. This will develop a better understanding of the impacts of exploitation of deep-sea resources and provide guidance for environmental impact assessments.

Timescale

Short term	• To establish a framework towards seabed and habitat mapping; combining mapping of geology, resources and biodiversity, defining a geographic scope, identifying integrated study sites to focus relevant data collection as well as relevant infrastructures and their limitations. • Build on outcome of JPI Oceans' Pilot Action on deep-sea mining, strengthen research through joint activities, which also address the use of models and combine with foresight studies.
Long Term	• Create a reference map of the deep-sea through international collaboration, designed for scientists, policy makers, industry, and society.

2. Technology and Sensor Developments



© Picture Credit: Submersible JAGO- JAGO-Team, GEOMAR Helmholtz Centre for Ocean Research Kiel

Rationale

Marine and maritime industries face a number of common challenges. Public-private partnerships across sectors can create scale economies promoting Blue Growth, creating employment and strengthening competitiveness. They can deliver breakthroughs on a range of enabling technologies including structures, platforms, new materials, sensors and marine bionics.

A long-term approach to cross-sectorial technological cooperation is required. In particular, new applications for maritime technologies in extreme environments (deep-sea, seabed, Arctic) require new material properties and functions. They need to be reliable, safe, efficient, economically feasible, and environmental friendly over their entire life cycle.

Activities

- **Working towards the creation of an oceans technology and engineering community** from which cross-sectoral joint actions and public-private partnerships in specific research areas will be launched to strengthen Europe's global competitiveness. Activities will focus on technologies for maritime operations and platforms on the surface and in the deep-sea.

- **Research for the qualification and development of new materials for new applications under extreme environmental conditions:** Activities will address the qualification of materials and concepts for new applications under extreme environmental conditions, and the development of new materials, structures and functional principles by learning from nature (bionics and biomimetics).

- **Sensors development for autonomous operation:** Activities will focus on the development of new sensors to monitor physical, chemical and biological parameters by integrating knowledge on marine environmental research, nano-materials, electronics, biotechnology and ICT. This should include the miniaturisation and improvement of the power systems for both platforms and sensors to increase their autonomy.

Timescale

Short term	• Establish a framework for actions and knowledge exchange to create an oceans technology and engineering community. This should include the organisation of workshops to develop research and industry hubs and create critical mass and address the needs for technologies for maritime operations (marine control systems, mooring technologies, remote operations etc.) to make technology advances, exchange of personnel, capacity building and seek complementarity. • Support the launch of calls aiming at improving underwater and other vehicles and platforms capacities for monitoring, surveying and sampling. • Support actions combining modelling techniques with long-term and real life laboratory tests of new materials and structures.
Long Term	• Facilitate academic and industry platforms to align educational programmes within the action.

3. Science Support To Coastal and Maritime Planning and Management

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Rationale

With less available space on land, industries are increasingly competing for maritime space. Good planning and management is fundamental to promote sustainable growth, taking into account time, space and policy. Stability is a prerequisite in promoting investments, growth and jobs, and creating legal certainty; predictability and transparency will reduce costs for investors and operators.

European coastal areas are also under increasing pressures from pollution, climate change and intensive use by humans. Agreed standards to assess various human activities and industries, according to the principles of sustainable development, are essential for effective management and planning.

Interdisciplinary research to support maritime spatial management is needed to integrate environmental concerns into the planning of multi-industrial activities in coastal and marine areas.

Activities

- **Develop a common strategy for sustained long-term monitoring of human impacts and climate change in coastal areas**. Activities will pave the way towards an integrated, long-term platform for European coastal monitoring. This will be achieved through exchanging practice, agreeing on standards, identifying data gaps, proposing actions to cover the gaps and coordinating at national and EU level to optimise monitoring of coastal areas.

- **Research to understand marine ecosystems goods and services** and their environmental, economic and social value. Integrating these concepts into management, advancing towards an ecosystems approach to develop a sustainable maritime economy, while ensuring the Good Environmental Status of the marine environment.

- **Research on the land-sea interface**: Activities will take into account the need for the use of existing and the development of new economic and environmental models. It will be based on a multi-disciplinary approach engaging industry and policy makers to enhance predictive capabilities and the development of new services based on user requirements.

Timescale

Short term	• Developing a transnational network of scientific institutions responsible for providing advice to policy needs related to spatial planning (MSP, CFP, MSFD, WFD).
Long Term	• Develop and implement an integrated monitoring strategy for coastal observation. • Enhance research on the land-sea interface combined with the increased use of integrated models and ecosystems goods and services. • Build an efficient interdisciplinary scientific community for industry and policy-relevant knowledge.

4. Linking Oceans, Human Health and Wellbeing

© Picture Credit: Playa Nudista de Combouzas en Arteixo | Flickr - jl.cernades

Rationale

The marine environment and human health and wellbeing are interlinked in ways we are only beginning to understand. These interactions are highly complex and can be classified both in terms of risks and benefits which need to be better understood.

The nature and extent of ocean and human health interactions is complicated by environmental change and degradation in our coastal seas and oceans driven by unsustainable activities, growing populations and climate change. There is a need to enhance our predictive capability for both biotic and abiotic environmental influences on human health and well-being.

Activities

- **Research to understanding the public health burden from human interactions with the ocean**. The research should focus on the range of negative consequences for human health (including loss of life) arising from changes, damage and degradation of coastal and marine ecosystems as a result of natural disasters or human activity.

- **Investigating the processes involved in the transport and transmission of toxins (biogenic) and toxicants (man-made) from the marine environment to humans.** This includes the impact of consumption of contaminated seafood or toxins produced by the phytoplankton species involved in harmful algal blooms (HABs) which can lead to a range of chronic and acute symptoms. A sufficient predictive capability for both biotic and abiotic environmental influences on human health and well-being can only be developed with expertise from a diverse range of disciplines across natural, social and economic sciences, including public health and medicine.

- **Exploring the benefits to human wellbeing of interacting with coastal and marine environments.** Contributing to the increasing research evidence on the health benefits for people interacting with the coastal and marine environment, referred to as Blue Gym.

Timescale

Short term	• Promote interdisciplinary research regarding interactions between oceans and human health.
Long Term	• Establish a network of Centres of Excellence on oceans and human health within Europe. • Develop dedicated graduate training programmes in oceans and human health.

5. Interdisciplinary Research for Good Environmental Status

© Picture Credit: MARUM - Center for Marine Environmental Sciences

Rationale

Achieving Good Environmental Status (GES) requires a good understanding of marine ecosystems and how multiple activities impact the environment. Despite the progress of the Marine Strategy Framework Directive, achieving GES requires improvements in several areas. Analysis of the first phase of MSFD implementation has shown that progress is needed to monitor and assess GES more efficiently. It has also shown that Member States need to cooperate more at a regional level to develop comparable indicators and a common understanding of what GES means.

Improvements in technology, monitoring and innovative approaches can be used to develop a better understanding of the GES indicators; in some cases these developments will cover new and emerging threats and pollutants. Robust scientific advice is needed to ensure that regular updates to the understanding of GES are presented to policy makers in an efficient manner.

Activities

- **Promote the exchange of knowledge, best practices and cooperation** among different countries and networks to contribute to a harmonised, comprehensive assessment and monitoring of human activities, as a basis for implementation of the EU Marine Strategy Framework Directive (MSFD).

- **Act as a hub to address acute risks (including emergencies) and disasters** (e.g. related to pollution risks of dumped munitions, shipwrecks etc.) inside and outside the EU by putting in place temporary panels of experts to assess the issues and propose solutions.

- **Research to address gaps in knowledge relating to harmful algae blooms** on marine ecosystems, maritime economy and human health. To assess the links between HABs, climate change and human impacts it is necessary to determine the combined effect of short-term decadal-scale climate variation and anthropogenic pressures.

Timescale

Short term	• Establish a portal and a flexible system, temporarily engaging experts in hubs to address emergency issues and ensure rapid advice from science to policy on risk assessment and possible scientific and technological solutions. • Enhance the networks of research institutions to address current barriers to a common understanding and coherent assessment of GES in European waters.
Long Term	• Research to address the effects of eutrophication and harmful algal blooms (HAB) on marine ecosystems, maritime economy and human health. • Research on critical pollutants in the marine environment to inform future GES assessments.

6. Observing, Modelling and Predicting Ocean State and Processes

© Picture Credit: Global Landcover Facility Image processing: German Aerospace Center

Rationale

Sustained long-term observations are required to understand the interactions between the marine environment, climate change, human activities and the combined effects of these on the oceans. Physical, chemical, biological, ecological, and geological data need to be integrated to form a holistic understanding of hazards, risks and changes in the marine environment.

Ocean observations require a range of infrastructures which are expensive to develop, operate, maintain and upgrade. This calls for an overarching coordination and prioritisation of research and monitoring capacities through a strategy driven by societal needs.

Activities

- **Support the set-up of an European Ocean Observing System (EOOS) strategic vision.** This should include tools and mechanisms such as a monitoring strategy to allow integration of existing European oceans observation and monitoring capacities which are important to enable a number of JPI Oceans' strategic objectives. The EOOS vision should also address the need for a long-term plan for observing technologies (see also strategic area 4.2).

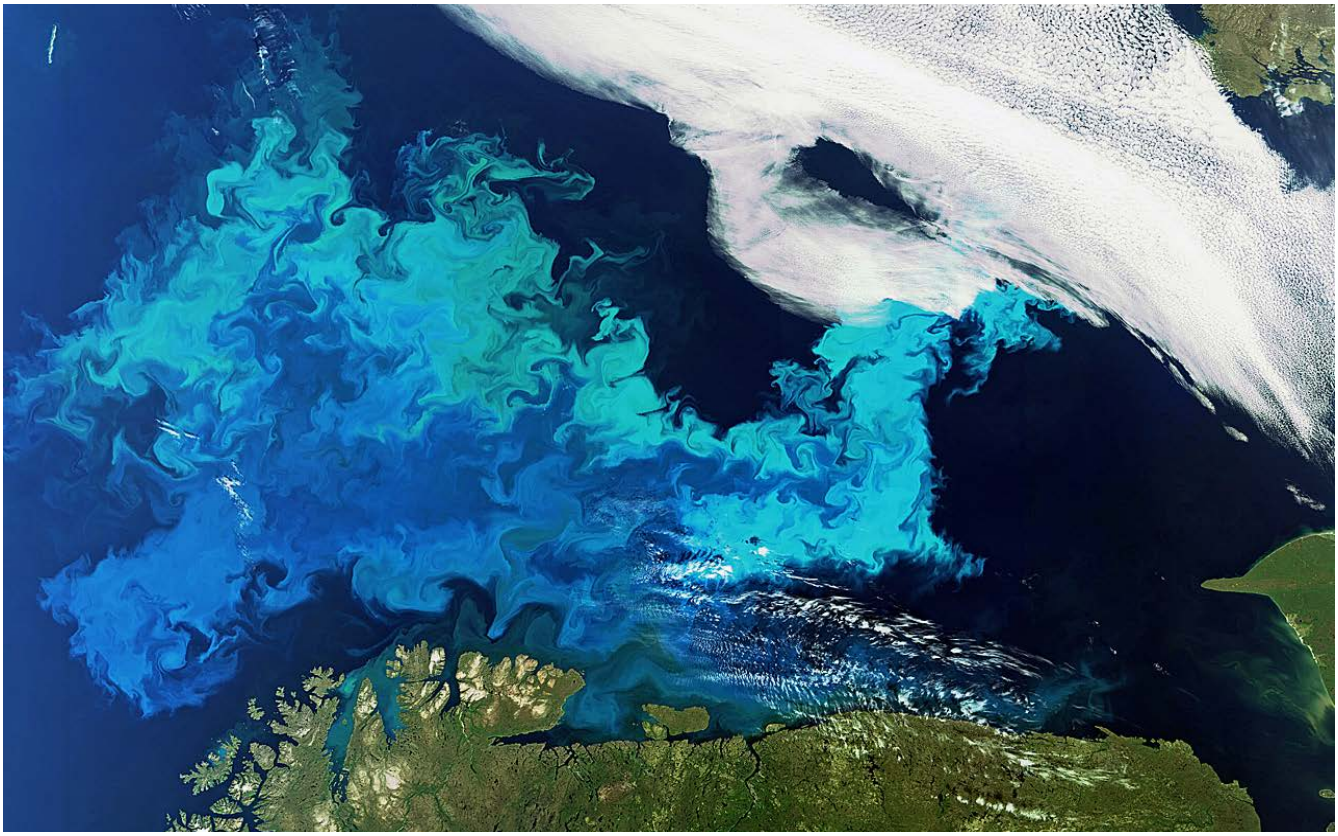
- **Promote common standards and open access to data** and the harmonisation of data requirements in particular related to MSFD.

- **Support e-infrastructures for computing, modelling, forecasting, and early warning systems.** Member Countries of JPI Oceans will collaborate to develop integrated e-infrastructures and, where relevant, common modelling frameworks.

Timescale

Short term	• Engage in a dialog with EuroGOOS and other relevant initiatives and networks to investigate the establishment of an EOOS strategic board for the development of a strategic vision for the European Ocean Observing System. • Promote common standards and open access to data. • Develop a monitoring strategy embedded in EOOS responding to science and policy dual uses and needs, identifying infrastructure gaps and which infrastructures to sustain at a pan-European level.
Long Term	• Develop a long-term plan for observing technologies (as part of the EOOS vision). • Support actions to improve and foster access to existing high performance computing facilities (e.g. PRACE), to ocean modelling frameworks, allowing several ocean related components of the earth system to work together or separately (e.g. NEMO), and to forecasting capacities (e.g. My Ocean). • Promote the development of a world class network of marine data centres adopting common standards. • Link EOOS with its international counterparts (IOOS or GOOS, Neptune, Donet, IMOS) (as part of the EOOS vision).

7. Climate Change Impact on Physical and Biological Ocean Processes



© Picture Credit: MERIS: plankton blooms: ESA

Rationale

Climate change is a global threat which will impact the natural environment, economies and well-being of humankind. Changes to the earth ocean system range from long-term reductions in sea ice coverage and thickness in the Artic, to changes in ocean circulation and sea-level rise.

There is a need for long-term monitoring, surveying and modelling to understand the processes and feedback mechanisms between the ocean and atmospheric systems. This should be conducted at both global and regional scales, and provide evidence from long-term, quality-controlled datasets and process-based understanding.

Activities

- **Research to understand impacts of climate change on ocean circulation, biogeochemical processes and the effects on ecosystem dynamics and pelagic ecosystems.** This should include primary production trophic web interactions and distribution, abundance of marine organisms, changes in biodiversity and the spread of invasive species.

- **Establish a long-term monitoring programme to follow changes in the thermohaline circulation** (THC) and deep water mass formation processes. Develop better models to predict future changes to the system and the potential for cooling and sea level rise in Western Europe.

- **Research to understand past environmental changes in connection to climate variability.** Historical and paleo data, ocean observing and forecasting systems should be integrated to provide better indicators of past, current and future environmental status.

Timescale

Short term	• Support an open annual European forum or network to address reliability of models and coordinate, organise and plan further activities between research centres and large national infrastructures. • Research on impacts of climate change on ocean circulation and effects on pelagic ecosystems and ecosystem dynamics. • Multidisciplinary scientific research to understand past environmental changes in connection to climate variability.
Long Term	• Establish a long-term monitoring programme, linked to EOOS and GOOS, to follow changes in the thermohaline circulation.

8. Effects of Ocean Acidification and Warming on Marine Ecosystems

Rationale

Ocean acidification has been recognised as one of the major challenges for marine ecosystems in the coming decades. Monitoring of ocean acidification across the European regions, from estuaries and coasts to open ocean, and its relationship with warming, remains largely underdeveloped.

Effects of ocean acidification, de-oxygenation and warming require long-term aligned research, concerted monitoring effort and modelling. This must be based on common methods and protocols. Efforts must be scaled up in under-sampled areas, such as the deep-sea, to understand the impacts on ecosystems.

Activities

Work towards a long-term monitoring programme to address the effects of ocean acidification and warming, to strengthen our knowledge of the combined effects of warming and acidification and de-oxygenation on marine ecosystems.

Research combining development / improvement of models and experimental research addressing: The combined effects on marine pelagic and shallow benthic ecosystems; the carbon cycle and the cycles of other key elements and processes such as ocean hypoxia; relationship between and combined impacts of climate change and human pressures; improved methods and models to reduce the uncertainty of projections on the carbon cycle in regional seas.

Research to improve our knowledge on the impact of acidification and warming on vulnerable deep-sea habitats and their biodiversity to support development of sustainable management measures as well as assessing climate risks in marine protected areas.

Timescale

Short term	• Strengthen our knowledge of the combined effects of warming and acidification on marine ecosystems. • Improve our knowledge on the impact of acidification and warming on vulnerable deep-sea habitats and their biodiversity. • Establish a sustainable pan-European network to ensure critical mass and a long-term approach to deal with the effect of acidification and warming on the marine environment.
Long Term	• Upscale monitoring efforts in under sampled and vulnerable areas.

9. Food Security and Safety Driving Innovation in a Changing World

© Picture Credit: mrak_hr/ iStock/ Thinkstock

Rationale

According to FAO, food supply will have to increase 60% by 2050 to meet the demands of a projected population of 9 billion. Rising demand is driving innovation in fish capture and seafood production.

In parallel with this market pull, environmental pollutants from anthropogenic sources are introduced, dispersed and accumulated in seafood through trophic transfer, posing a risk to human health. New management strategies and regimes for food production systems are needed to respond to pressures on food webs resulting from climate change, physical degradation, competing uses, and fisheries induced evolution.

Responding to these complex challenges calls for a framework where scientists from different disciplines work together. In particular, there is a need to integrate fisheries and aquaculture research with omics, environmental, social, and economic research.

Activities

- **Technological developments in aquaculture production** including research on innovative feeds, and research based on DNA sequencing brood stock, new species and stock baselines adapted to climate change impacts.
- **Foster engagement** between marine fisheries, aquaculture and land-based food production to maximise sustainable food production and sound governance.
- **Develop a better understanding of multiple pressures on food webs** and how they impact on fisheries and aquaculture such as the effects of eutrophication and harmful algal blooms (HAB).
- **Development of new models and address data needs** to ensure sustainable fisheries and a GES of populations of commercial fish species (descriptor 3 of MSFD).

Timescale

Short term	• Establish a multi-disciplinary pan-European network of scientists to address changes in food production and socio-economic implications. • Develop a pan-European network of aquaculture stakeholders for monitoring and sharing practice, and seek agreement on standards and risk assessments, including developing future integrated marine farming systems.
Long Term	• Support new models and a more comprehensive information and database on species interactions on food webs (including non-edible species) and population dynamics. • Develop a long-term network of aquaculture research infrastructures to strengthen research in automation and enhance the design and operation of marine biological production and harvesting systems. • Develop a European network of top class experimental facilities, improving transnational access, coordination, and integration of national aquaculture programmes.

10. Use of Marine Biological Resources Through Development and Application of Biotechnology

Rationale

In 2010 marine biotech was estimated to be a 2.8 billion euro industry by the European Science Foundation, with a large potential for growth. The sector is also considered as an enabler to other industries.

This reflects an increasing need for developing tools and knowledge for sustainable development of marine based products, including food, feed, nutraceuticals, cosmeceuticals, biomedical, biopolymers, enzymes with industrial applications and a range of other commodities.

Activities

- **Support actions towards the exploitation of genetic resources**, including bio-prospecting, identification, and the valuation of biological resources. Activities will establish a maximum sustainable yield (MSY) for the use of marine bio-resources to avoid overexploitation and assess the impact and risks from exploiting marine biodiversity.

- **Research to enhance knowledge of taxonomy and genomics** to provide policy advice for Blue Growth and GES. This action will include genome bioinformatics and computational biology, sequence and structure analysis, molecular evolution and omics technologies.

- **Develop new organism models to understand basic biological, ecological and evolutionary processes** which underpin the discovery of biotechnology and application of biomimetics.

- **Support coordinated efforts along the value chain** from marine biomass to markets to reduce the EUs dependency on imports of biomass. This implies increased supply of marine bioresources through sustainable cultivation of biomass like micro and macro algae and integrated multitrophic aquaculture.

Timescale

Short term	• Commercial assessment with industries, through brokerage events to identify uses and stimulate development of marine bio-refineries. • Funding capacity building in bioinformatics, omics and high-throughput technologies, and for application in 'molecular' aquaculture.
Long Term	• Research programme targeting a multidisciplinary approach across the biomass producers and technology providers supported by marine science and market needs. • Joint activities and investment in innovative strain cultivation strategies and platform for high-throughput microbial cultivation, and development of new model organisms. • Development of a global biological research infrastructure vision to contribute to European capacities for leading edge research in marine biology, biodiversity and biotechnology.

Cross-Cutting Initiatives

In addition to the Strategic Areas, three cross-cutting issues have been identified where JPI Oceans can add value in the European landscape.

Science-Policy Interface

High quality scientific information is needed to support evidence-based policy decisions. The challenge for the scientific community is to transfer reliable, robust and impartial evidence into complex policy arenas. In the context of JPI Oceans, science-policy has two meanings. Being driven by policy makers, JPI Oceans must ensure that all policy relevant scientific research carried out as part of a joint programming activity is effectively targeted towards and communicated to relevant policy mechanisms. Secondly, JPI Oceans is in a position to improve and add value to existing science-policy mechanisms.

Science-Policy Initiatives
Promote better and faster use of existing knowledge from different disciplines
Create better capacity of science-policy at European Level
Initiating specific actions in relation to the implementation of the MSFD
Stimulate Co-design of research programmes and science based policy at Pan-European Level
Signpost experts to relevant policy requirements
Raise awareness of ocean issues to stakeholders, policy makers and general public

Human Capacity Building

Boosting capacity is essential to solve societal problems. The current ERA-NET tools are too short to effectively invest in education such as PhDs. As a long-term strategy, JPI Oceans is well placed to create a strategy to ensure that capacity building is translated into actions.

Human Capacity Building Initiatives
Training and education
Jointly recognised educational modules
Long-term plan for human resources development
Develop science-policy capacities
Launch a Knowledge and Innovation Community (KIC

Infrastructures: Shared Use and Common Procurement Strategies

The shared use of research infrastructures and sustained cost effective observing systems are issues which would benefit from the new cooperation mechanisms offered by JPI Oceans. A high political commitment and dialogue between the relevant authorities is required and JPI Oceans offers a platform for such a dialogue to develop common procurement strategies and associated business plans. These can be adapted for the optimal use of costly infrastructures, by bringing together relevant authorities, users and producers.

Infrastructures Initiatives
Develop a common vision for marine research infrastructure use and access
Set-up common procurement strategies and develop common business plans
Strengthen land-based facilities and develop in situ testing sites for ocean engineering, shipbuilding, ocean energy, sub-sea technologies and instrumentation

CHAPTER 3

Delivery of the SRIA

In this first iteration of the SRIA, the basis for the future activities conducted in the context of JPI Oceans has been laid down, with priorities and timescales indicated. To implement this SRIA, joint actions are being planned and taken forward and led by Member Countries. Actions will identify the users and producers from the outset to ensure relevance and uptake. The JPI Oceans' Implementation Plan presents a menu on how actions can be taken foward from which Member Countries select relevant activities. The Operational Plan will be a living document presenting the actions and activities which JPI Oceans is carrying out in its operational phase. For more information see Annex VI.

JPI INSTRUMENTS

JPI Oceans seeks to make use of the broadest range of investments, funding opportunities and other instruments available for research, human capacity, infrastructure and innovation at regional, national and European level such as:

- national research programme funds, institutionalised investments, in-kind capacities and contributions (human resources, infrastructure);
- structural funds;
- grants and projects;
- fostering networking and research alliances (across the innovation chain);
- mechanisms to foster open access to knowledge, data and information.

As explained in the role of JPI Oceans, Pilot Actions test experimental novel tools, methods and multifaceted processes to add value to the ERA landscape. To facilitate this, JPI Oceans has proposed and delivered a toolkit of proposed procedures (Annex V).

Building on the mapping and gap analysis and consultation process, the JPI Oceans Management Board has highlighted new research needs which the European Commission could consider for the Horizon 2020 work programmes. Additionally, the use of existing EC instruments such as public – public partnerships (ERA-NETs, ERA-NET Plus, ERA-NET COFUNDs or Article 185), infrastructures, mobility and training grants will enhance the ability of participants to work together in the implementation of the JPI Oceans Strategic Research and Innovation Agenda.

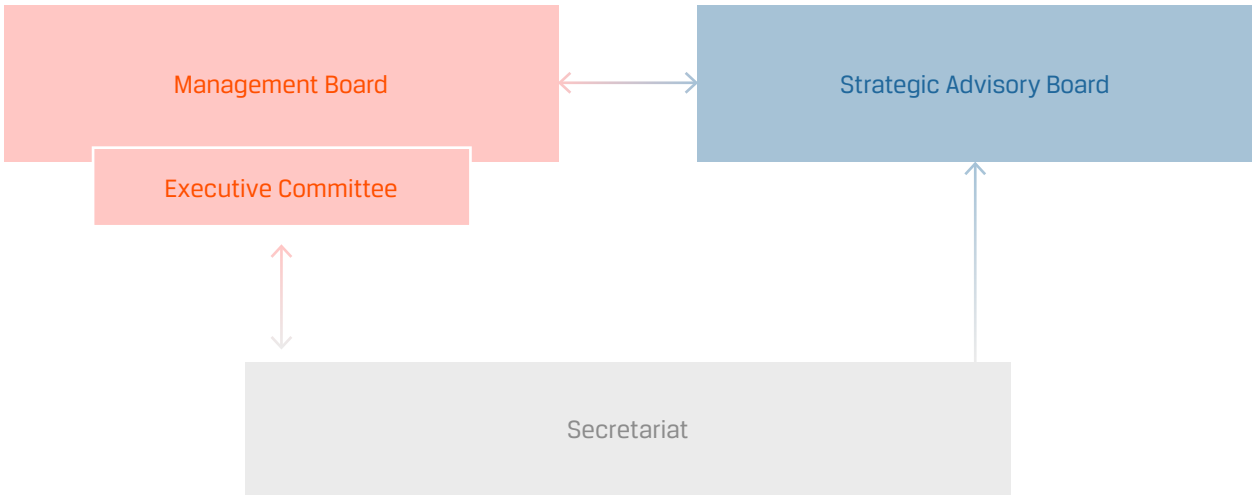
Evaluation and Monitoring

Individual joint actions will be monitored and evaluated to ensure optimal implementation in the JPI Oceans process as well as informing the development of future actions. For each action evaluation criteria and metrics will be developed, tailor made and embedded from the start. In particular it is envisaged that mid-term evaluations will be undertaken to enable actions to evolve, taking account of their progress and external developments. The impact and success of individual actions will be tracked and highlighted in the Operational Plan and through regular reporting to the Management Board. Lessons learnt from the Pilot Actions will inform the approach to subsequent activities.

In addition the JPI Oceans process as a whole will be monitored and evaluated to ensure that it is fulfilling its objective of aligning national research programming in Europe, having a structuring effect. A set of indicators will be developed to test the outcomes and impacts of the process. The progress of JPI Oceans will be regularly assessed by the Member Countries through the Management Board, informed by inputs from the Strategic Advisory Board and external experts.

The wider involvement of the Member Countries and the European Commission through the GPC committee will also be ensured and the recommendations of the JPI-COWORK and ERALEARN projects will be taken into account in the development of the specific evaluation criteria. Further detail on the proposed evaluation process is set out in the Implementation Plan.

Annex I: JPI Oceans Governance Structure



Management Board

The Management Board (MB), the decision-making body of JPI Oceans, has the overall responsibility for the implementation of JPI Oceans. All Member Countries participating in JPI Oceans are represented in the Management Board (MB). The representatives from each country have sufficient authority to agree on joint action plans and potential funding initiatives across Europe.

Executive Committee

The Executive Committee (ExCom) is an executive body, advising the Secretariat and providing support and assistance to the Management Board during the development and implementation of JPI Oceans governance, plans, actions and activities.

Strategic Advisory Board

The Strategic Advisory Board (StAB) provides independent, integrated and strategic advice to the JPI Oceans' Management Board. The StAB is made up of independent experts from science, industry and civil society. Each of the StAB members are appointed in their own capacity and not as representative of any organisation or stakeholder group.

Secretariat

The Secretariat is committed to facilitating and supporting the work conducted by JPI Oceans' Member Countries as efficiently and effectively as possible.

Annex II: Overview of the Consultation Process

The development of the SRIA has been a collective, shared and forward-looking exercise, identifying and prioritising cross-cutting research, development, and innovation challenges for our seas and oceans. Through the CSA Oceans project, JPI Oceans has gathered a vast collection of baseline information which will serve as a 'knowledge bank' for later assessment and evaluation of the objectives of JPI Oceans.

Key questions addressed in the consultation focused on:

- The key challenges in a 20-30 years perspective;
- How JPI Oceans can add value through better use of national investment and resources. Specifically in regard to R&D and innovation, including human capacities and infrastructures and identify barriers to these;
- Gaps and needs in the marine and maritime field, including: R&D, innovation, infrastructures, technologies, human capacities and science to policy;
- How to increase cooperation across Europe and internationally.

The consultation process involved:

- An extensive mapping exercise and desk based research;
- A series of workshops during the summer of 2013 involving over 60 European and international stakeholder groups, organisations, networks, platforms and projects;
- An online open consultation;
- A Research Funding Agencies consultation (2013-2014), via a questionnaire to identify the key challenges and opportunities for the future and to gather information on functioning and mapping of: national R&D and innovation systems, science to policy mechanisms, and, national research strategies and programs. This questionnaire was sent to the 20 JPI Oceans Member Countries and one observer country. In addition, the questionnaire was sent to 6 other European and non-European countries with coastal areas (Croatia, Cyprus, Greece, Israel, Latvia and Slovenia).

The JPI Oceans Strategic Advisory Board members have been actively engaged in a series of meetings and workshops to develop the themes and provide advice to Member Countries on the relative priorities, urgency and feasibility of the actions. Joint meetings of the StAB and the Management Board helped formulate the thematic priority areas for action. The Management Board members also carried out their own consultations at national level.

This is the public version of the SRIA.

Annex III: Members of JPI Oceans Management Board

Chair: Caron Montgomery

Vice Chair: Lourdes Armesto

Country	Organisation	Name
Belgium	Belgian Federal Science Policy Office (BELSPO) Flemish Government, Department Economy Science and Innovation (EWI) Fonds National de la Recherche Scientifique (FNRS)	*Contact: Frank Monteny* *Contact: David Cox* *Contact: Dirk Van Melkebeke* *Contact: Gert Verreet* *Contact: Freia Van Hee*
Denmark	National Institute of Aquatic Resources (DTU-DTU Aqua) Danish Agency for Science, Technology and Innovation (DASTI)	*Contact: Torger Børresen* *Contact: Susanne E. Hede* *Contact: Floor ten Hoopen*
Estonia	Ministry of the Environment of the Estonian Republic University of Tartu; Estonian Marine Institute (EMI) Ministry of Agriculture University of Tartu; Institute of Ecology and Earth Sciences	*Contact: Silver Vahtra* *Contact: Henn Ojaveer* *Contact: Eve Külmallik* *Contact: Kalle Olli*
Finland	Finnish Environment Institute (FEI/SYKE) Academy of Finland, Research Council for Biosciences and Environment	*Contact: Mari Walls* *Contact: Kyösti Lempa*
France	French Research Institute for Exploitation of the Sea (IFREMER) French National Research Agency (ANR)	*Contact: François Jacq* *Contact: Gilles Lericolais* *Contact: Maurice Heral* *Contact: Patrick Monfray*
Germany	German Federal Ministry of Education and Research (BMBF) German Federal Ministry of Food, Agriculture and Consumer Protection Research Centre Jülich (JÜLICH)	*Contact: Christian Alecke* *Contact: Wiebke Rüdt von Collenberg* *Contact: Hartmut Stalb* *Contact: Joachim Harms*
Greece	Hellenic Centre for Marine Research (HCMR) Ministry of development; General Secretariat for Research and Technology (GSRT)	*Contact: Evangelos Papathanassiou* *Contact: Chrysoula Diamanti*
Iceland	Marine Research Institute Iceland (MRI) Icelandic Centre for Research (RANNIS)	*Contact: Johann Sigurjonsson* *Contact: Sigurdur Björnsson*
Ireland	Marine Institute Ireland (MI)	*Contact: John Evans* *Contact: Peter Heffernan*

Country	Organisation	Name
ITALY	National Institute of Oceanography and Experimental Geophysics (OGS) Italian Ministry of Infrastructure and Transport, Directorate of Maritime Transport and Inland Waterways Italian Consortium for Managing research Activities Venice Lagoon (CORILA) National Research Council of Italy, Marine Technology Research Institute (INSEAN-CNR)	CONTACT: ANGELO CAMERLENGHI CONTACT: ENRICO MARIA PUJIA CONTACT: PIERPAOLO CAMPOSTRINI CONTACT: EMILIO FORTUNATO CAMPANA
LITHUANIA	Ministry of the Environment of the Republic of Lithuania (AM) Research Council of Lithuania	CONTACT: DALIUS KRINICKAS CONTACT: VIKTORIJA VAŠKEVICIENE CONTACT: BRIGITA SERAFINAVIČIŪTĖ CONTACT: AUDRIUS ŽVIKAS
MALTA*	University of Malta, Physical Oceanography Unit (UM)	CONTACT: ALAN DEIDUN
NETHERLANDS	Ministry of Economic Affairs, Agriculture and Innovation (EL&I) Netherlands Organisation for Scientific Research (NWO) on behalf of the Ministry of Education, Culture and Science	CONTACT: INO OSTENDORF CONTACT: J.M. DALHUISEN CONTACT: JOSEF F. STUEFER CONTACT: BERNARD WESTEROP
NORWAY	Research Council of Norway (RCN) Norwegian Ministry of Fisheries and Coastal Affairs	CONTACT: CHRISTINA ABILDGAARD CONTACT: KRISTIN ELISABETH THORUD CONTACT: ARNE BENJAMINSEN CONTACT: JARTRUD STEINSLI
POLAND	Polish Academy of Sciences; Institute of HydroengineerinW PAN)	CONTACT: GRZEGORZ RÓŻYŃSKI
PORTUGAL	Portuguese National Funding Agency for Science, Research and Technology (FCT) Portuguese Institute of Ocean and Atmosphere (IPMA)	CONTACT: ALEXANDRE FERNANDES CONTACT: NUNO LOURENÇO
ROMANIA	National Authority for Scientific Research, Directorate for European Integration and International Cooperation University of Bucharest, Faculty of Geology and Geophysics	CONTACT: VIOREL VULTURESCU CONTACT: VIOREL GH. UNGUREANU
SPAIN	Spanish Ministry of Economy and Competiveness (MINECO)	CONTACT: LOURDES ARMESTO
SWEDEN	Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS) Swedish Agency for Marine and Water Management (HaV)	CONTACT: LISA ALMESJÖ CONTACT: ANNA JÖBORN
TURKEY	Tübitak Marmara Research Center	CONTACT: CINAR ONER
UNITED KINGDOM	Department for Environment, Food and Rural Affairs (DEFRA) National Oceanography Centre (SOTON-NOCS) Natural Environment Research Council (NERC)	CONTACT: CARON MONTGOMERY CONTACT: ED HILL CONTACT: MIKE WEBB

* Malta is an observing member to the JPI Oceans Management Board

Annex IV: Members of JPI Oceans Strategic Advisory Board

Chair: Peter Herzig

Vice Chair: Manuel Barange

Name	Institute
Manuel Barange	Plymouth Marine Laboratory (PML)
Catherine Boyen	Centre National de la Recherche Scientifique; Station Biologique de Roscoff (CNRS-SBR)
René P.A. Dekeling	Ministry of Infrastructure and the Environment - Directorate-general for Spatial Development and Water Affairs
Laura Giuliano	Italian National Research Council - Institute for Coastal Marine Environment
Arturo González Romero	INNOVAMAR
Peter Herzig	Helmholtz Centre for Ocean Research Kiel (GEOMAR)
Jørn Krog †	County Governor of Sør-Trøndelag
Karin Lochte	Alfred Wegener Institute for Polar- and Marine Research (AWI)
Niall McDonough	European Marine Board (ESF-EMB)
Jean-Francois Minster	TOTAL
Sigve Nordrum	Aker BioMarine Antarctic
Sevcan Çolpan Polat Beken	Scientific and Technological Research Council of Turkey (TÜBITAK)
Eeva-Liisa Poutanen	Ministry of the Environment of Finland
Frank Roland	Centre of Maritime Technologies e.V. (CMT)
Yvonne Shields	Commissioners of Irish Lights
Nils Christian Stenseth	University of Oslo, Centre for Ecological and Evolutionary Synthesis (UiO-CEES)
Wendy Watson-Wright	Intergovernmental Oceanographic Commission (IOC)

Annex V: ACKNOWLEDGMENTS

The JPI Oceans Management Board gratefully acknowledges and thanks the many people who have contributed to the development of JPI Oceans and in particular, those who responded to the stakeholder consultations, and the Strategic Advisory Board (StAB).

The development of JPI Oceans' strategic research agenda and Implementation Plan has been underpinned by a Coordination and Support Action from the European Commission (FP7 CSA Oceans-Grant agreement no. SCS2-GA-2012-314194-CSA Oceans, 1 September 2012-31 August 2015)3 and the direct support of the Secretariat activity by Norway, Belgium, Italy, Spain, France, Germany. We thank all the partners involved.

CSA Oceans is an EU FP7 project which facilitated the implementation of JPI Oceans in its start-up phase. The project was launched on 1 September 2012. The Deliverables of CSA Oceans have been instrumental in developing this Strategic Research and Innovation Agenda. The published deliverables are:

Identification of new and cross-cutting technologies and solutions to boost blue growth

Improving Science-Policy Interfaces: Recommendations for JPI Oceans

Mapping and preliminary analysis of infrastructures, observation - data and human capacity building

Mapping and preliminary analysis of policy needs for evidence

Mapping of maritime research and innovation strategies and funding

Needs and gaps analysis in marine sciences to feed the SRIA

Needs and gaps in infrastructure and human capacity building to feed the SRIA

Proposal for procedures for design and management of joint actions

A programmatic foresight process for JPI Oceans

Communication plan JPI Oceans

Update the JPI Oceans Early gap analysis

Foresight for JPI Oceans - Definition and review of relevant processes

Annex VI: HIERARCHY OF JPI OCEANS DOCUMENTS

The development of JPI Oceans can be charted by the key documents it has published. The structure below shows hierarchy of agreed strategic decisions taken by the Management Board in the development of the JPI Oceans.

Vision Document 3 Goals 10 Objectives	During the preliminary phase of JPI Oceans, a common Vision Document was developed outlining the long-term goals and objectives of JPI Oceans. In September 2011 the Management Board adopted the Vision Document together with an overview of gaps to feed the Strategic Research and Innovation Agenda; an overview of the policy drivers for JPI Oceans; and a document expressing how JPI Oceans perceives its links to other JPIs.
SRIA 10 Strategic Areas 3 Cross-Cutting Areas	The SRIA is a high level document which sets out the ten strategic areas JPI Oceans will act in order to align and add value in the ERA landscape. It draws on a long version which was developed by CSA Oceans. The JPI Oceans Management Board adopted the SRIA in December 2014.
Implementation Plan 43 Actions 12 Cross-Cutting Initiatives	The Implementation Plan provides a long-term menu of action for the Management Board in the 10 strategic areas of JPI Oceans. It presents 43 actions and 12 cross-cutting initiatives, with fit for purpose tools, which could be taken forward by JPI Oceans both now and in the future.
Operational Plan 2015-2016	The Operational Plan is a living document which presents active actions and activities of JPI Oceans. It will facilitate monitoring, evaluation and ensure feedback mechanisms to ensure that JPI Oceans is a learning and adaptive initiative.

JPI Oceans

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