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ATLANTIC MARITIME INNOVATION
CLUSTERS - EXPRO

Executive Summary Report (ESR)

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Contents

Why EO Matters to the Maritime Sector	3
Project Approach	3
Main Findings.....	4
Marine Operations and Navigation	4
Ecosystem and Natural Capital Management	4
Maritime Security and Infrastructure Resilience	4
Technology Opportunities and Capability Gaps.....	6
Environmental DNA (eDNA) technologies.	6
Capability Mapping and International Collaboration.....	6
Pilot Projects.....	7
Blue Ecosystems Monitoring at Scale (BEMS)	7
Enhanced Metocean Information Service (EMIS)	7
Maritime Security and Resilience Applications (MSRA)	7
Stakeholder Engagement and Communications	8
The EO4MI Innovation Roadmap	8
Conclusions and Future Outlook	8

The EO4MI (Earth Observation for Maritime Innovation Clusters) project was delivered by Marine South East Ltd (MSE International) for the European Space Agency (ESA) under Contract No. 4000144465/24/I-LR. The activity was established to accelerate the adoption of Earth Observation (EO) technologies within maritime innovation ecosystems and to support the development of new information services that address operational, environmental and economic challenges facing the Atlantic maritime sector.

The project built upon the legacy of ESA's Atlantic Regional Initiative and associated Blue Economy programmes, which had previously identified significant opportunities for applying EO technologies to maritime challenges. EO4MI was designed to move beyond identifying opportunities and towards establishing a practical framework for co-creating innovative services that integrate satellite Earth Observation, in-situ sensors, communications technologies, advanced analytics and operational decision-support systems.

The activity addressed a broad range of maritime sectors, including marine renewable energy, ocean surveillance, fisheries, aquaculture, ports, infrastructure, environmental management and maritime security. Its purpose was to identify user needs, assess current technological capabilities, engage stakeholders, define future innovation priorities and develop a roadmap for implementing practical EO-enabled services across the Atlantic region.

Why EO Matters to the Maritime Sector

The maritime economy is undergoing rapid change. Governments, businesses and communities face increasing pressure to improve environmental sustainability, strengthen resilience to climate change, protect critical infrastructure and support economic growth. Many of these challenges depend on better information about the marine environment.

Satellite Earth Observation has become an increasingly important source of information for monitoring oceans, coasts and maritime activities. However, many users do not require satellite data itself. Instead, they need reliable information and actionable insights that support operational decisions.

EO4MI therefore focused on understanding how EO technologies can be integrated with other data sources and emerging technologies to create services that solve real-world problems. The project confirmed that future value will come not from satellite observations alone, but from combining EO with autonomous systems, communications networks, artificial intelligence and user-centred service design.

Project Approach

The project was organised into two principal phases.

The first phase focused on understanding market demand, identifying innovation opportunities and mapping existing capabilities. Extensive analysis examined user requirements, sector priorities and the current state of Earth Observation technologies.

The second phase translated these findings into implementation plans. Activities concentrated on stakeholder engagement, international collaboration, pilot project development and the creation of a long-term innovation roadmap.

A central feature of the project was engagement with a wide network of stakeholders from industry, research organisations, public authorities, innovation clusters and international institutions. This collaborative approach ensured that recommendations and future projects were grounded in genuine operational needs rather than purely technical possibilities.



BUILDING BLOCKS BUILDING BLOCKS OF EO4 MARITIME INNOVATION

Main Findings

Analysis conducted across multiple maritime sectors revealed three dominant areas where demand for improved information services is strongest:

Marine Operations and Navigation

Maritime operators increasingly require timely and accurate information to support planning, safety and efficiency. Applications include vessel routing, offshore energy operations, search and rescue activities, environmental response and the management of autonomous systems. Existing services often lack the resolution, timeliness or integration needed for demanding operational environments.

Ecosystem and Natural Capital Management

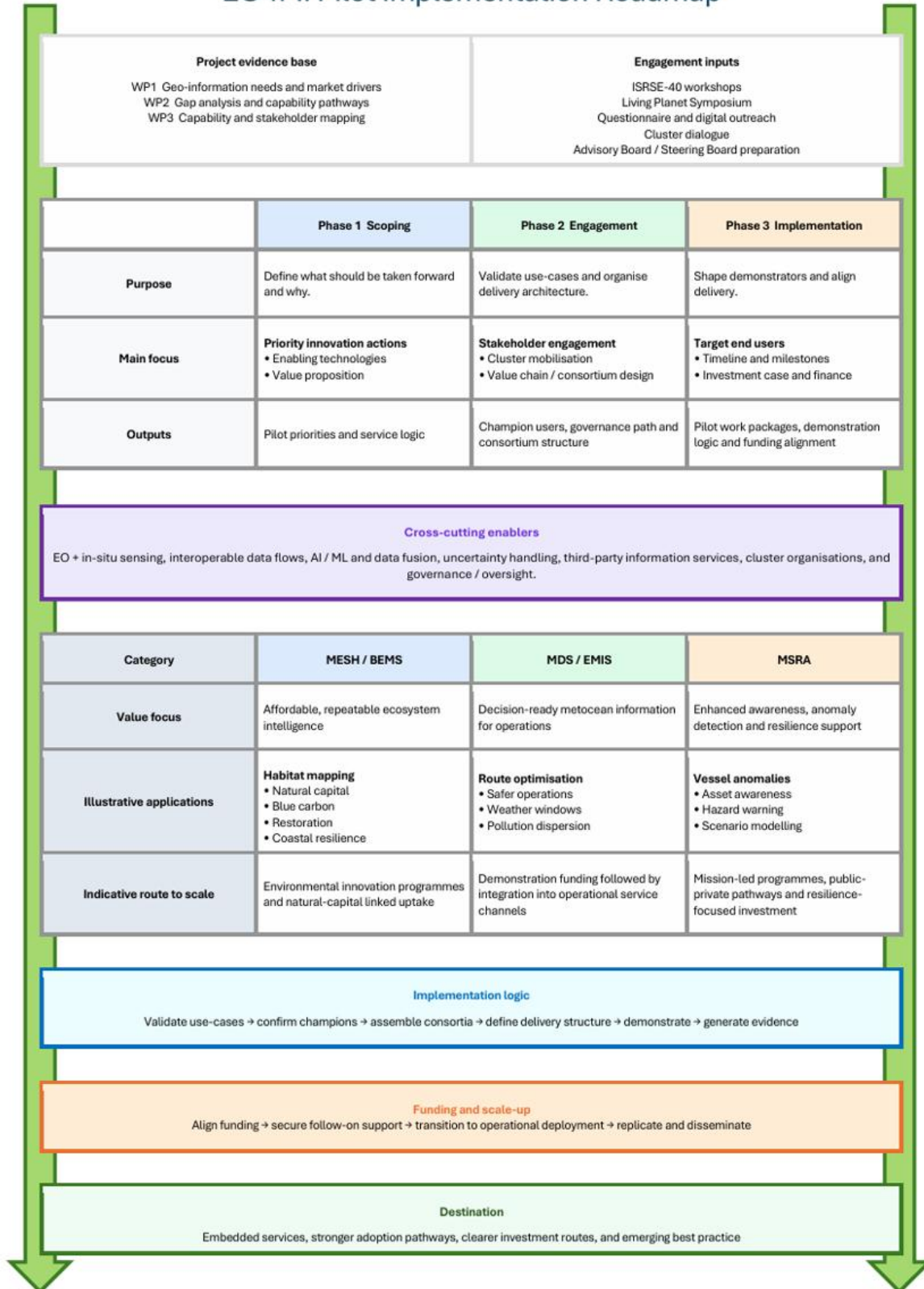
Growing emphasis on biodiversity protection, habitat restoration and blue carbon initiatives is creating significant demand for improved environmental monitoring. Marine Protected Areas, natural capital accounting and ecosystem restoration programmes all require better evidence regarding habitat condition and ecological change. Current monitoring approaches can be costly, labour intensive and geographically limited.

Maritime Security and Infrastructure Resilience

Increasing concern regarding the protection of critical underwater infrastructure has highlighted the need for enhanced maritime awareness. Subsea cables, pipelines, offshore energy installations and other strategic assets require improved monitoring and risk management. EO technologies offer opportunities to strengthen surveillance, anomaly detection and resilience planning.

These three themes emerged consistently throughout stakeholder consultations and form the foundation of the EO4MI roadmap.

EO4MI Pilot Implementation Roadmap



Technology Opportunities and Capability Gaps

The project identified considerable progress in Earth Observation capabilities, including advances in optical imagery, synthetic aperture radar, ocean monitoring missions and environmental data services. However, stakeholders also highlighted important limitations that currently constrain operational use.

The most significant challenges include:

- Limited access to near real-time information.
- Insufficient spatial detail for some applications.
- Weak integration between EO and in-situ datasets.
- Limited use of advanced analytics and data fusion.
- Lack of decision-support tools tailored to user requirements.

Several emerging technologies were identified as particularly important for addressing these gaps:

- Very high-resolution satellite imagery.
- Advanced radar-based Earth Observation systems.
- Autonomous marine vehicles.
- Satellite communications.
- Artificial intelligence and machine learning.

Environmental DNA (eDNA) technologies.

- Multi-source data fusion platforms.

The project concluded that transformative innovation is most likely to occur when these technologies are combined into integrated information services rather than developed in isolation.

Capability Mapping and International Collaboration

EO4MI conducted an extensive assessment of organisations, expertise and innovation capabilities across six Atlantic countries:

- United Kingdom
- Ireland
- France
- Spain
- Portugal
- Norway

The mapping exercise identified considerable strengths throughout the maritime innovation ecosystem, including Earth Observation providers, autonomous systems developers, communications providers, research institutions and digital technology companies.

Particular strengths were found in:

- Data acquisition and sensing technologies.
- Environmental monitoring systems.
- Artificial intelligence and advanced analytics.
- Digital maritime services.
- Satellite communications and telemetry systems.

The project also demonstrated strong international interest in Atlantic maritime innovation priorities. Engagement with global maritime networks, cluster organisations and international stakeholders showed that the challenges identified by EO4MI are widely shared and create opportunities for international cooperation and market expansion.

Pilot Projects

A major output of EO4MI was the development of three pilot initiatives designed to demonstrate how EO-enabled services can address priority maritime challenges.

Blue Ecosystems Monitoring at Scale (BEMS)

BEMS focuses on improving the monitoring of marine habitats and ecosystem services. The concept combines satellite observations, autonomous survey platforms, biodiversity assessment techniques, artificial intelligence and community-generated information.

The objective is to create a scalable and cost-effective approach to monitoring habitats such as seagrass meadows and other coastal ecosystems that play an important role in biodiversity conservation, climate regulation and natural capital management.

Expected benefits include improved habitat mapping, support for blue carbon initiatives, better ecosystem management and reduced monitoring costs.

Enhanced Metocean Information Service (EMIS)

EMIS aims to improve environmental intelligence for maritime operations by integrating Earth Observation data, oceanographic models and in-situ observations.

The service concept targets applications such as offshore renewable energy, shipping, pollution response and search and rescue operations. By enhancing the quality and usability of forecasts and environmental information, EMIS seeks to improve operational efficiency, safety and decision-making.

Maritime Security and Resilience Applications (MSRA)

MSRA addresses emerging requirements for maritime surveillance, infrastructure monitoring and resilience planning.

Potential applications include the protection of subsea cables, offshore energy infrastructure and coastal assets. By integrating EO data, vessel tracking, autonomous monitoring systems and AI-enabled analytics, the concept aims to provide enhanced situational awareness and early warning capabilities.

Although currently at an earlier stage of development than the other pilots, MSRA represents an important strategic opportunity for future growth.

Together, these pilot concepts demonstrate how EO technologies can generate practical operational value across environmental, economic and security domains.

Stakeholder Engagement and Communications

Stakeholder engagement was central to the project's success. Two major EO4MI workshops were organised, complemented by participation in international conferences, sector events and industry forums.

The project established a broad network spanning industry, research organisations, government bodies and international institutions. A dedicated webinar attracted registrations from seventeen countries, reflecting growing international interest in the EO4MI approach.

Further engagement activities included presentations and discussions at events such as ISRSE, the Living Planet Symposium, National Oceanography Centre workshops, Marine Measurement Forum activities and Blue Tech Cluster Alliance meetings. These activities helped validate project findings and build support for future implementation.

The EO4MI Innovation Roadmap

One of the most important outcomes of the project is the EO4MI Innovation Roadmap. Rather than focusing solely on technology development, the roadmap introduces a structured methodology for creating user-centred maritime services.

The roadmap adopts a value-chain approach that connects:

- Sensors and Earth Observation assets.
- Autonomous and in-situ monitoring platforms.
- Communication networks.
- Data integration and analytics.
- Information services.
- Operational decision-support tools.

The methodology begins with identifying a validated user challenge, develops a service concept that addresses that challenge, quantifies the value created and builds the partnerships necessary to implement and commercialise the solution.

This approach was successfully tested through the development of the three pilot projects and provides a repeatable framework for future maritime innovation activities.

Conclusions and Future Outlook

EO4MI has demonstrated that strong demand exists for advanced Earth Observation-enabled services across the maritime sector. The project confirmed that future innovation will depend on integrating multiple

technologies and stakeholders across the entire information value chain, rather than focusing on individual technologies in isolation.

The project has produced:

- A clear understanding of maritime user needs.
- Identification of priority innovation opportunities.
- Mapping of Atlantic capabilities and stakeholder networks.
- Three pilot projects with implementation potential.
- A scalable innovation roadmap and co-creation methodology.

The next priority is to convert the pilot concepts into funded implementation projects, establish long-term governance arrangements and expand international collaboration. Successful implementation would create new opportunities for economic growth, environmental stewardship and maritime resilience across the Atlantic region and beyond.

The EO4MI project therefore provides ESA, industry, government and research organisations with both a strategic vision and a practical framework for accelerating the uptake of Earth Observation technologies in support of a more sustainable, resilient and competitive Blue Economy.