



**Hatfield**  
CONSULTANTS

*Environmental Specialist Since 1974*



## **Earth Observation for Oil and Gas**

# **Roadmap for Development of Earth Observation in the Oil and Gas Sector**

*Deliverable 3 – ESRIN/AO/1-7568/13/I-AM - Value Added Element*

**January 2015**

*Prepared for:*

**European Space Agency**  
Frascati (RM), Italy

# EARTH OBSERVATION FOR OIL AND GAS ROADMAP FOR DEVELOPMENT OF EARTH OBSERVATION IN THE OIL AND GAS SECTOR

(DELIVERABLE 3 – ESRIN/AO/1-7568/13/I-AM – VALUE ADDED ELEMENT)

*Prepared for:*

**EUROPEAN SPACE AGENCY**  
VIA GALILEO GALILEI  
I – 00044 FRASCATI (RM)  
ITALY

*Prepared by:*

**HATFIELD CONSULTANTS PARTNERSHIP**  
#200 – 850 HARBOURSIDE DRIVE  
NORTH VANCOUVER, BC  
CANADA V7P 0A3

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## DISTRIBUTION LIST

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Name	Firm	Email	OGEO Portal
Ola Grabak	ESA	✓	✓
Geoff Sawyer	EARSC	✓	✓
Members	OGEO Portal		✓

## AMENDMENT RECORD

This report has been issued and amended as follows:

Issue	Description	Date	Approved by
1	First version of "Earth Observation for Oil and Gas: Deliverable 3 – Roadmap for Development of Earth Observation in the Oil and Gas Sector"	20150123	 Dr. Andy Dean Project Manager

## 1.0 BACKGROUND

The **Earth Observation for Oil and Gas (EO4OG)** project was established by the European Space Agency (ESA) in March 2014 to provide a base for the potential development of **EO guidelines for the on-shore and offshore oil and gas sector**. The EO4OG project was implemented by a consortium of four companies that currently provide services, including EO services, to the oil and gas sector. Hatfield Consultants and OTM Consulting focused on the onshore oil and gas sector, while CLS and C-CORE focused on the offshore. The EO4OG project teams engaged with the oil and gas industry, notably through the **International Oil and Gas Producers Association (IOGP)** (EO Subcommittee of the Geomatics Committee).

The objective of the EO4OG project was to assess the oil and gas industry geo-information requirements and EO usage within key thematic areas. The project was structured into two tasks:

- **Task 1** – assessed the oil and gas sector challenges and geo-information requirements across the project lifecycle, for both offshore and onshore. This information was compiled based on an industry consultation and expert review conducted through the EO4OG project; and
- **Task 2** – assessed the capabilities of EO to address these challenges and needs. Capabilities were documented in the form of EO “product sheets” and case studies of EO application in the oil and gas sector. A gap analysis was conducted to evaluate EO capabilities in relation to industry requirements.

An **EO4OG Industry Workshop** was held on November 18, 2014, in London to present the project findings, with a **Workshop Report** summarizing the findings from the workshop. All project findings are added to the OGEO Portal (<https://wiki.ogeo-portal.eu>), a gateway to information and a community of users dealing with EO products and services for the oil and gas industry.

## 1.1 PURPOSE

The purpose of this report is to construct a high-level roadmap for a range of activities following the completion of the EO4OG project. Discussions at the EO4OG Industry Workshop indicated that a roadmap specifically for EO guideline development was premature. It was considered more appropriate to define a broad set of options and next steps to build upon the outputs of the EO4OG Project, rather than focusing on guidelines.

## 1.2 SCOPE

The EO4OG project addresses satellite EO technology, whereas EO encompasses platforms including aerial survey, un-manned aerial vehicles, and ground-based systems. Within the oil and gas sector, EO is considered one tool within overall mapping technologies.

The scope of this roadmap is to provide recommendations and actions regarding how to further develop awareness of and appropriate usage of satellite EO within the onshore oil and gas sector. This includes the complete onshore oil and gas project lifecycle, from pre-license acquisition, exploration, development, production phases, through to the decommissioning phase.

The activities covered under the roadmap include EO guidelines, training, and communications. Where possible, a description of work including tasks, deliverables, milestones and estimated resource requirements is provided.



## 1.3 INSTITUTIONAL CONTEXT

This section provides a summary of the institutional context for the implementation of the EO4OG project and this roadmap.

### 1.3.1 Oil and Gas Industry

Oil and gas exploration and development companies include super-majors, multi-nationals, national oil companies, and numerous smaller exploration and development companies. The oil and gas industry comes together to form a range of associations and initiatives to advance the mutual interests of companies and other stakeholders.

#### 1.3.1.1 International Oil and Gas Producers Association

IOGP members produce more than half the world's oil and about one third of its gas, and operate in all the oil producing regions of the world – North America, South and Central America, Africa, Europe, the Middle East, Russia & Caspian region, Asia & Australia.

The IOGP was a key partner for the EO4OG project. The IOGP committees and task forces manage the exchange and dissemination of good practice through publications and events around the world. Members of the EO Sub-committee of the Geomatics committee provided considerable support and inputs to the EO4OG project, recognizing the value of the EO4OG project in supporting the EO Sub-committee vision and objectives (Box 1). IOGP has published several guidelines that are relevant to the EO4OG project – see Table 1.

#### Box 1 IOGP EO sub-committee vision and objectives.

##### IOGP EO sub-committee Vision

- To encourage the usage and maximise the benefits of EO in the oil & gas industry and to facilitate the communication between the EO service providers and the oil & gas sector.
- To assist in the development of industry guidelines, good practice and specifications for the use of EO and its derived value-added products.
- To provide a communication platform to facilitate opportunities for information exchange, and to provide an interface to other organisations in the field of Earth Observation.

##### IOGP EO sub-committee Objectives

- Development of industry guidelines, good practices and specifications for EO technologies
- Assist the OGP in addressing issues and questions where EO technologies (existing or new) can be of benefit to the business outcome
- Support Joint Industry Projects (JIP) and taskforces where EO data or technologies are required. Potential candidates are:
  - Oil Spill Preparedness & Response
  - Environmental Baseline Mapping & Monitoring
  - Sea Ice Tracking and Monitoring
  - Ocean Current Monitoring & Modeling

- Communication of EO obtained geo-information and its value to the industry
  - Develop and further advance the OGEO Web-Portal
  - Help in facilitating workshops and meetings, as well as represent OGP at industry and EO-related events

### 1.3.1.2 IPIECA

IPIECA<sup>1</sup> is the oil and gas industry association for environmental and social issues, formed in 1974 following the launch of the United Nations Environment Programme (UNEP). IPIECA's membership covers over half of the world's oil production. IPIECA helps the oil and gas industry improve its environmental and social performance by:

- Developing, sharing and promoting good practices and solutions;
- Enhancing and communicating knowledge and understanding;
- Engaging members and others in the industry; and
- Working in partnership with key stakeholders

IPIECA currently has member-led working groups that address the following areas: biodiversity; climate change; health; oil spill preparedness; fuels and products; reporting; social responsibility, and water<sup>2</sup>. IPIECA has published several guidelines that are relevant to the EO4OG project – see Table 1.

### 1.3.1.3 Joint Industry Projects

Joint industry projects (JIPs) are an important mechanism for the oil and gas industry to work together on important issues, enabling the industry to share expertise and resources and bring direct benefits to all members of the JIP and the industry as a whole. Numerous JIPs are ongoing at any time, usually initiated discreet projects. Funding may be provided by each JIP member to enable the use of external consultants to support the JIP implementation. Alternatively, a JIP may use internal company resources – so called “sweat equity.”

In response to the April 2010 Gulf of Mexico (Macondo) oil spill incident, an Oil Spill Response JIP (OSR-JIP) initiated discreet projects or provides support to projects initiated by other trade associations. The OSR JIP is being managed by IPIECA on behalf of IOGP in recognition of its long-standing experience with Oil Spill Response matters. An important output of the OSR-JIP is the Common Operating Picture (COP), which addresses the important role that geo-information technologies can play. The COP provides key information to stakeholders including the responders, public, NGOs and government agencies in a timely manner. The initial reports on the COP include the development of open standards for the integration of distributed information.

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<sup>1</sup> When IPIECA was set up in 1974 the acronym stood for the International Petroleum Industry Environmental Conservation Association. In 2002, recognising that this no longer accurately reflected the breadth and scope of the association's work, IPIECA stopped using the full title. The association is now known as IPIECA, the global oil and gas industry association for environmental and social issues.

<sup>2</sup> <http://www.ipieca.org/about-us>



### 1.3.1.4 Existing Guidelines and Guidance Notes

A range of guidelines and guidance notes and best practices are available, published by the IOGP and other trade associations such as IPIECA. Some relevant guidelines and other documents are provided in Table 1.

**Table 1 Existing oil and gas industry guidelines and EO-related content.**

Title	Date	Author	EO related content
Management and remediation of sites in the petroleum industry. An IPIECA Good Practice Guide.	July 2014	IPIECA	<ul style="list-style-type: none"> <li>▪ Base map of the site, current use and setting</li> <li>▪ Mapping topography, ground and surface water flow</li> <li>▪ Mapping infrastructure</li> <li>▪ Site accessibility</li> </ul>
Good practice guidelines for the development of shale oil and gas.	Dec 2013	IOGP	<ul style="list-style-type: none"> <li>▪ Minimising operational footprints</li> <li>▪ Biodiversity and ecosystem services approach, managing the potential fragmentation of habitats.</li> <li>▪ Consider the cumulative impacts on local land use</li> </ul>
Sensitivity mapping for oil spill response.	April 2012	IPIECA/OSR-JIP	<ul style="list-style-type: none"> <li>▪ Type of shore</li> <li>▪ Villages and coastal land use, aquaculture</li> <li>▪ Infrastructure</li> </ul>
Oil and gas exploration and production operations in mangrove areas - guidelines for environmental protection.	Dec 2008	IOGP	<ul style="list-style-type: none"> <li>▪ Vegetation cover</li> <li>▪ Drainage patterns</li> <li>▪ Fishing and aquaculture areas</li> <li>▪ Seismic survey planning</li> </ul>
Oil Industry operating guideline for tropical rainforest.	April 1991	IOGP	<ul style="list-style-type: none"> <li>▪ Current land use</li> <li>▪ Environmental impact assessment</li> <li>▪ Identification of sensitive areas</li> </ul>

### 1.3.2 Earth Observation Service Providers

The commercial EO industry has entered a new era and satellite platforms, sensors, images, and the delivery systems for information products are increasingly components of a well-established service industry. The EO services industry is dedicated to the development and use of EO data processing and exploitation tools to provide information for decision makers. This industry is mainly composed of small and medium-sized enterprises.

The **European Association of Remote Sensing Companies** (EARSC) is a non-profit organisation, actively involved in coordinating and strengthening the EO chain and promoting the European geo-information industry. EARSC develops tools and schemes to support suppliers and buyers of EO services, including a Certification Scheme and EO Pages<sup>3</sup>, a marketplace between the EO service industry and users. Other EO industry associations also exist, notably the Earth Observation Industry Alliance (EOIA) in the United States.

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

### 1.3.3 European Space Agency

Through the Earth Observation Envelope Programme (EOEP), ESA plans and develops remote sensing technologies and missions. Through the EOEP, a diverse series of innovative instruments and missions have been designed and launched. The EOEP includes “Earth Explorer”, aimed to respond to the requirements of the scientific community through new sensing technology. The “Development and Exploitation” component includes all preparatory activities for future missions.

ESA implements the Value Adding Element (VAE) to support European and Canadian geo-spatial information industry to develop and grow the prospects of EO services being used in business and organizations for their operations.

**Copernicus** is a European set of systems which collect data from multiple sources: EO satellites and in situ sensors such as ground stations, airborne and sea-borne sensors. These data are processed to provide users with reliable and up-to-date information through a set of services related to environmental and security issues. The Sentinels are a series of satellites that will provide a unique set of observations for Copernicus:

- Sentinel-1 provides all-weather, day and night radar imagery for land and ocean services, with Sentinel-1A launched on 3 April 2014. Sentinel-1B is planned for launch in 2015.
- Sentinel-2 will provide high-resolution optical imagery for land services. The first Sentinel-2 satellite is planned for launch in 2015.

### 1.3.4 Other Organisations

A sector as important and diverse as the oil and gas industry is supported through the activities of a number of other organisations. Several organisations have an interest and an active role in the development of EO technologies:

- Petroleum Environmental Research Forum (PERF<sup>4</sup>), a non-profit organization created to provide a stimulus to and a forum for the collection, exchange, and analysis of research information relating to the development of technology for health, environment & safety, waste reduction and system security in the petroleum industry; and
- Pipeline Research Council International (PRCI), a global collaborative research organization of, by, and for the energy pipeline industry, has a program to develop EO products and services for the pipeline industry, particularly for ground movement and encroachment surveillance.

## 2.0 ROADMAP

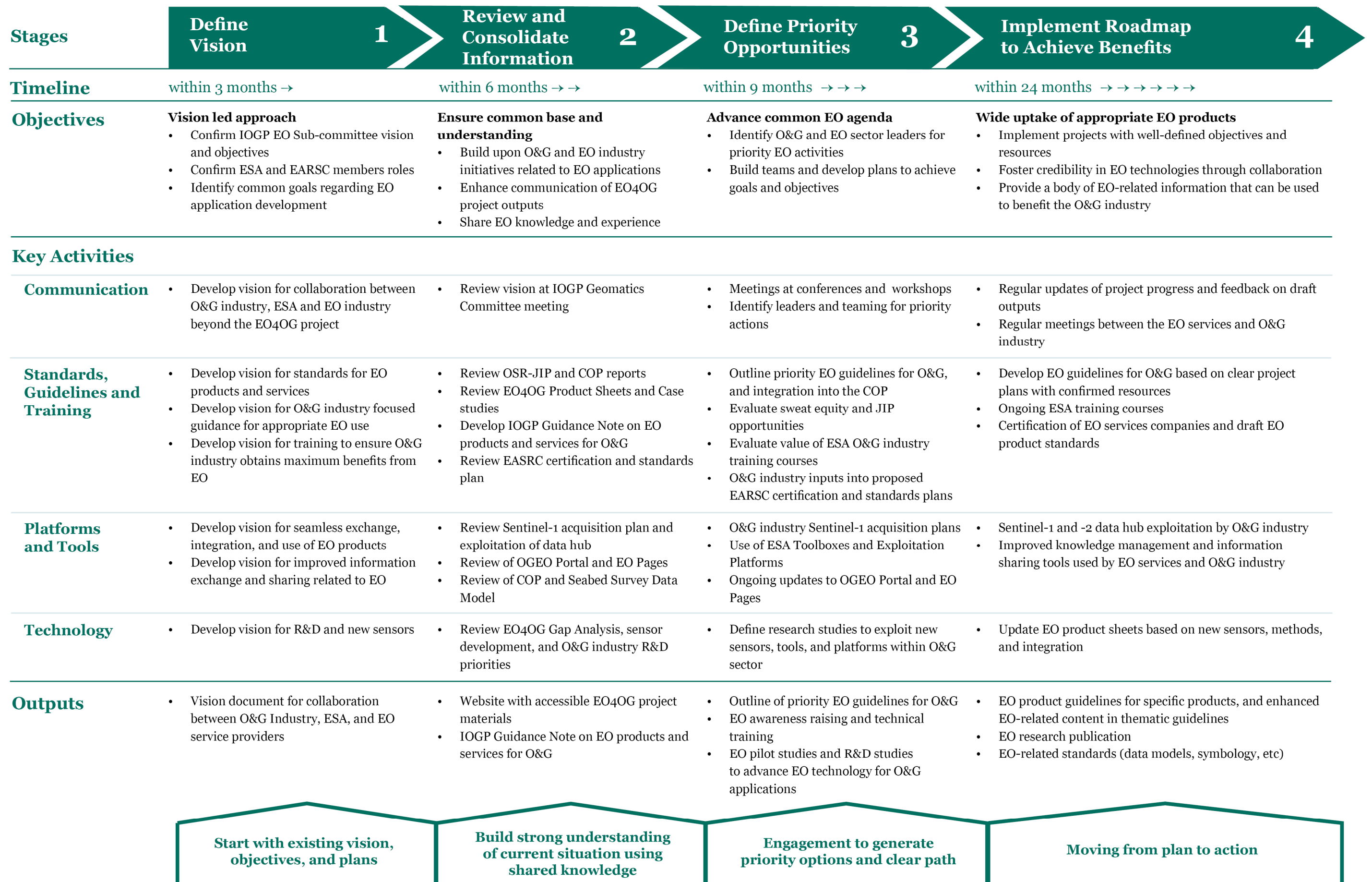
The roadmap presents a set of options and next steps to build upon the outputs of the EO4OG Project. Rather than focusing only on EO Guidelines, the roadmap includes other high-level development activities that would be appropriate following the EO4OG project.

The roadmap follows a high level schedule, where activities and outputs are completed in an overall 24 month period, with stage milestones for within 3 months, within 6 months, within 9 months, and within 24 months. Within each stage, the roadmap defines: 1) objectives; 2) activities; and 3) outputs. The activities are separated into: communication; standards, guidelines, and training; platforms and tools, and technology development. The roadmap is illustrated in Figure 1 and the main elements are discussed in the following sub-sections.

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<sup>4</sup> <http://www.perf.org/>

Figure 1 Roadmap for the development of EO technologies within the oil and gas sector.



## 2.1 COMMUNICATION

The EO4OG project and other ongoing initiatives by EARSC and the IOGP present an opportunity for improved collaboration between the EO services industry and the oil and gas industry to increase the overall adoption of appropriate EO capabilities.

The immediate communications objective is to confirm roles and define common goals regarding EO application development in the oil and gas sector. This can be achieved by:

- Reviewing the effectiveness of communications through the EO4OG project and OSR-JIP;
- Ensure that regular meetings take place between EO service providers and oil and gas industry, through workshops and meetings, and representation at oil and gas industry events;
- Identification of leaders within the EO services industry and oil and gas industry to develop specific projects or initiatives. Ensure communication and updates are provided from any future projects that include EO data or technologies.

Resources required for communication activities should primarily be internal resources from the oil and gas industry, EO service providers, and other supporting agencies such as ESA. EARSC have provided leadership in hosting the OGEO Portal, and ESA and EARSC will work together in 2015 to update the web presentation of outputs from the EO4OG Project. ESA will also support communications materials such as brochures related to the EO4OG project.

The upcoming IOGP Geomatics Committee meeting in the first quarter of 2015 provides an important opportunity to review and define communications.

## 2.2 STANDARDS, GUIDELINES, AND TRAINING

Through the EO4OG project and OSR-JIP, a large body of information has been generated related to the application and integration of EO technologies by the oil and gas sector. These outputs must be reviewed by the EO services industry and oil and gas industry.

Through the EO4OG project, the role of satellite EO technologies as a component of geospatial information services or solutions to the oil and gas sector was recognised. Other EO platforms such as manned and unmanned aerial systems need to be considered as complementary technologies where appropriate in order to ensure standards and guidelines best support the oil and gas industry.

The priority initial activity is to develop the vision for standards, guidelines and training in the use of EO within the oil and gas sector. Based on this vision, IOGP will identify candidate EO product guidelines as well as areas where existing or ongoing thematic guideline development could integrate additional content on satellite EO. In several cases, existing guidelines point to aerial surveys and Google Earth as sources of geospatial data, which misses an opportunity to inform users regarding satellite EO products.

An IOGP *Guidance note on EO products for the onshore oil and gas sector* is an option in the short term, which may be preferable to an attempt to develop full EO guidelines. To move forward with development of potential EO guidelines and facilitate the collection of feedback, outlines of the content of potential guidelines should be developed. Recommended guidelines that are specific to satellite EO capabilities are *Land Use and Land Cover Characterization* and *Flood Extent Mapping*.

EO-based products and services need to be integrated into existing oil and gas sector processes, which requires standardization in how geo-information products are described and delivered. EARSC have made efforts to move the EO product standardisation and supplier certification agenda forward. At the same time, ESA have already made a commitment to implement EO training programs aimed at the oil and gas sector, with an event scheduled for 2015.

Resources are required to implement the activities proposed standards, guidelines, and training. The level of resources depends on the approved activities during the initial roadmap phases. An estimate of resources is provided:

- Guidance note on EO products for the onshore oil and gas sector: 20 days (IOGP and EO Services Industry);
- Outline of EO Guidelines products: 2 days each product (IOGP and EO Services Industry);
- EO Guideline for land cover characterisation: 60 days (EO Services Industry);
- Certification and product standards: 20 days/year (EARSC and EO Services Industry);and
- EO Training Programmes: 60 days/year (ESA).

## 2.3 PLATFORMS AND TOOLS

Following a review of the existing platforms and tools for information exchange and sharing, and EO data access, an updated vision is required to guide efforts in the area by all partners.

The OGEO Portal provides a web-based oil and gas sector communication platform to facilitate opportunities for information exchange and an interface for organisations between the IOGP, EO service providers, and the oil and gas sector. However, usage of the OGEO Portal, even during the EO4OG project, is sporadic and the community of users is not sufficiently active or sustainable. A similar situation is apparent with EO Pages – the content and structure require active updates to be useful.

Existing platforms should be reviewed and updated, and subsequently used and promoted. This can be supported by dissemination of useful and pertinent information by ESA, IOGP, and EARSC through the OGEO Portal, such as the outputs of the EO4OG project.

ESA Sentinel missions offer unique opportunities for EO satellite service providers to provide a range of applications and products to support the oil and gas sector through all phases of the sector lifecycle. The use of EO-based tools also offsets difficulties or issues with land- or air-based solutions, thereby accelerating the provision of high-quality, commercially valuable information. Integration is a critical issue for enabling the use of satellite EO data products by the oil and gas sector –lessons about knowledge management and information sharing can be learned through a review of OSR-JIP COP and the Seabed Survey Data Model:

- Review acquisition plan for ESA Sentinels and provide coordinated inputs to planning: 5 days (IOGP);
- Use of ESA Toolboxes and Exploitation Platforms;
- Provide updates to and promote use of OGEO Portal and EO pages as the go-to platform for information dissemination: 20 days/year (EARSC, ESA, IOGP).

The tools and platforms will contribute to improved communication of EO product capability that would enable the oil and gas sector to build a common understanding of how, when and where particular products should be used.

## 2.4 TECHNOLOGY

The EO4OG project gap analysis identified areas where EO-based product capabilities requires improvement through research and development to meet oil and gas sector information requirements. This information improves understanding about which EO products and services exist and how they might be applied within the oil and gas industry, and where improvements must be made.

It is in the interests of the IOGP, ESA, and EO services industry to collaborate to define studies and test cases to exploit new sensors, tools, and platforms to improve products.

The important first step is a review of the EO4OG project gap analysis, sensor development, and research and development priorities defined in the EO4OG project, as well those ongoing through other initiatives such as the OSR-JIP and PERF.

Research and pilot studies are needed to address issues and questions related to where EO technologies (existing or new) can be of benefit to the oil and gas sector. Areas of particular interest are:

- Elevation - satellite derived elevation products in comparison to LiDAR and/or unmanned aerial systems.
- Hydrocarbon seep detection and leak detection – application of hyperspectral sensors and persistent monitoring platforms.
- Methane emissions – research coordination with PERF using airborne and new satellite platforms and platforms.
- Land cover characterization, including specific sub-products such as monitoring of pipeline corridors and vegetation disturbance using ESA Sentinels and other persistent monitoring sensors.
- Air quality – application of hyperspectral sensors and models.
- Surface deformation monitoring – continued development of InSAR, including timeliness of deliver, accuracy, and integration into reservoir development models.

In order to stimulate ongoing discussion and investment in EO pilot studies and research, the EO services industry and oil and gas companies should continue to develop case studies showcasing the successful use of EO in the O&G sector.

## 3.0 FINAL CONSIDERATIONS

The EO4OG project and workshop was implemented by a collective of four independent consortia that consist of established service providers and consultants to the oil and gas sector. The EO4OG project enabled EO experts and users from the oil and gas industry to research, discuss, and assess the opportunities for oil and gas sector to adopt appropriate EO technologies, as well as current limitations in EO technologies in addressing industry needs.



Considerable information was generated during the EO4OG project and all the project findings are available in the OGEO Portal (<https://wiki.ogeo-portal.eu>).

The project, and the workshop in particular, stimulated lively discussion among EO experts from the oil and gas industry. It is important for ESA, IOGP members, and the EO services industry to maintain the momentum and interest developed. This roadmap provides a high level framework for short and longer term action related to: communications; standards, guidelines, and training; platforms and tools; and technology. The activities proposed would deliver benefits to all participants, with only modest resources required for completion of several important components of the roadmap.