IPOG Review

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1. Introduction

This document provides a review of the Innovation Programme in Oil and Gas (IPOG). IPOG was nominally a 5-year programme (2016-2021) with a budget of £5M. The Innovation Programme operated to the following general principles:

- Industry-led – Programme members defined the innovation challenges that need to be addressed.
- Openness - grants awarded in open competition and project outcomes open to all members.
- Translation-focused - translate existing research into outputs that meet the member's needs.
- Impact driven - Focused on benefiting society, the economy and the environment.

The original IPOG challenges comprised: Decommissioning; Extending the life of mature basins;

Associated with these challenges were three cross-cutting innovation themes:

- Innovative monitoring approaches
- Data management, sharing and collaboration
- Environmental management

Funding for projects directly associated with Oil and Gas was £1.55M, with a further £354k for a project aimed at renewables which also has Oil and Gas applications. Three funding rounds were supported as outlined in Section 4.

The programme was conducted under a Memorandum of Understanding, which clearly defined the responsibilities of all parties. NERC appointed a project coordinator in April 2019 to be a point of contact for members, look after the day to day running of the programme and monitor the projects.

1.1 Strategic evolution

The relevance of the original themes and challenges of IPOG were tested at both the IPOG meeting held at the MASTS Annual Science Meeting in October 2019, and during an IPOG members meeting. It was recommended that the 'unconventional hydrocarbons' challenge should be replaced by the Energy Transition. It was also recognised that the original purpose of Exploration in Challenging Environments should move from Arctic exploration to continuing deepwater exploration. The UK industry has also committed to net-zero emissions from production by 2040 and this is a challenge for future research support. Given the focus on the Energy Transition, it is apparent that that the present Oil and Gas industry should be considered as part of the solution to the future energy mix.

2. IPOG Members Feedback

IPOG attracted 9 members, which have been grouped in

Table 1 according to the type of organisation. The level of engagement and feedback varied significantly within the membership, with benefits derived from IPOG likely correlate with the degree of input into shaping the calls and assessment of proposals.

The programme attracted only one operator despite engagement with Oil and Gas UK (OGUK), the most significant representative body for the UK offshore oil and gas industry. No initial engagement was made with the International association of Oil and Gas Producers (IOGP), the international equivalent of OGUK.

Table 1 IPOG Members by organisation type

Oil and Gas Operator	Regulator	Service companies
Chevron North Sea Ltd	Marine Scotland JNCC Natural England	BMT Cordah Fugro Oil Spill Response AECOM Universal Pegasus International

2.1 Operator Engagement

The feedback from the only operator in the membership was that operators were underrepresented in the programme. This may be due to a combination of factors including:

- The launch of IPOG coincided with a significant decline in the oil price, from over USD100 to USD30-50, resulting staff cuts and significantly increased workload.
- Oil and gas company structures are complex and engaging the right people in a programme such as IPOG, often a combination of both innovation and operational functions, is challenging.
- Innovation is often viewed as an additional risk by operational functions of operators, so requires promotion by innovation functions within the operator.

2.2 Brokerage Events

The brokerage events prior to the Innovative Monitoring funding round were considered useful in bringing together regulators, industry operators, service companies and researchers. Member feedback suggested a lack of knowledge in industry about research undertaken in academia, and a lack of knowledge in academia about the needs of industry.

From the industry side this might be addressed through awareness of the Grant on the Web service which allows searching of research funded by UKRI-NERC. From the academic side it might be helpful for industry to create a needs view similar to the evidence requirements published by the MMO. Publication of the needs identified by industry from an IPOG Environmental Needs survey will provide a snapshot of present industry concerns.

The location of these events likely contributed to relatively poor attendance by operators. Aberdeen is the natural home of events associated with the UK oil and gas sector, with London being a good alternative.

2.3 Programme Management

The programme management was considered strong initially, but the restructuring of NERC within UKRI together with changes to innovation programmes created challenges. Earlier appointment of the Project Coordinator may have provided greater continuity in point of contact. A significant number of the members expressed regret that the anticipated digital/data funding call was not taken forward.

2.4 Projects

The view of projects was somewhat mixed. Several members expressed the view that the academic's focus was not always on the industry need and innovation, with projects being utilised to fund research interests rather than outcomes. Greater involvement of partners, potentially with a degree of funding, would help to deliver greater benefit. This perspective differed when partners were fully engaged in driving projects. The degree of satisfaction with the projects appears to be dependent on several factors including:

- Ethos of research organisation with respect to innovation projects and communication with partners. This perhaps reflects the 'normal' grant application procedure when academics gain letters of support from industry but have no obligation to deliver anything in return.
- Effort expended by members engaging with potential partners at brokerage events to formulate projects, particularly how outcomes might be proven and pathways to adoption developed.
- Some projects leveraged funds to further unproven low Technology Readiness Level (TRL) research which ultimately did not provide innovation.
- Some projects were overly ambitious resulting in late delivery.
- The capacity/ability to manage IP issues in the timescales of the projects was challenging
- Short term projects can be difficult to resource for some research institutes.

3. Project Coordinator Perspective

3.1 Operator Engagement

Operators are the ultimate clients in the oil and gas sector. However, service companies will generally be the party that delivers the outcomes of an innovation programme as products and services that. This delivery is made in compliance to the regulatory framework. This is an important consideration, as an oil and gas sector innovation programme usually requires all three organisation types – operator, service company and regulator - to develop strong projects.

Services companies are often conservative in nature as they often bear the brunt of operational risks in commercial contracts. Therefore, projects under innovation programmes need to reach TRL5 to encourage further innovation. Generally, this TRL will also be sufficient to satisfy the regulator that new approaches meet requirements. Unfortunately, TRL 5 places the projects in the "valley of death" (see Figure 1.)Follow on funding to entities seeking to commercialise outcomes of the innovation projects would help to ensure the science and technology ultimately provides a commercial or societal benefit - a key message from the MASTS IPOG meeting.

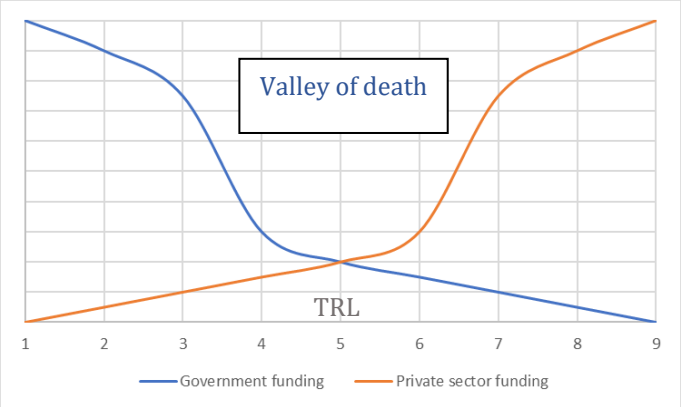

Figure 1 Origin of Investment across TRLs

3.2 Programme Management and Coordination

The primary activities undertaken under the programme since in April 2019 have been monitoring projects and dissemination of outcomes. Effort has also been expended in promoting the Innovation Programme to a wider audience, particularly through engagement with the industry trade associations such as OGUK and IOPG, and to help inform NERC's relationship with the Oil and Gas Industry moving forward.

Project monitoring was initiated with visits to each organisation to gain insight into how the projects were realised. Subsequent contact via telephone or video calls generally proved effective in monitoring progress. Dissemination was achieved through development of project descriptions in collaboration with the PIs. These were then disseminated to members and other interested parties, including OGUK Environment Forum, OGTC and IOGP.

The ability to commercialise NERC science and technology through licensing or other mechanisms was raised by a number of service companies. For Programme types such as IPOG it is strongly recommended that proposals include clarity of how the innovation would be commercialised.

4. Project Outcomes

Across all the funding rounds, the results have been disseminated through the publication of 20 Journal Articles, and 6 conference proceeding abstracts. The researchers have also engaged in 33 presentations, 12 formal working groups/expert panels and 9 workshop activities. Publications submitted by the researchers to ResearchFish are listed in Appendix A with project titles and lead research institute.

Some of the successful projects from each funding round are highlighted below.

4.1 Decommissioning 1

Two projects were funded in this phase, and both had successful outcomes. SAMS undertook analyses of pipeline data to create GIS layers, published by Marine Scotland, to identify the overlap between fishing activity and pipelines. The impact of potential decommissioning scenarios as functions of pipe diameter/ground type, rock dumping attributes, enhanced protection (e.g. mattresses') and enhanced exclusion zones around in-situ decommissioned pipelines were then assessed and tabulated.

University of Aberdeen investigated the application of automation of marine growth analysis. A key outcome was recommendations to industry on improving the routine imagery captured during integrity surveys.

4.2 Decommissioning 2

The 2nd decommissioning round included two projects which assessed the application of autonomous technology to environmental survey work. The drive to cut costs on routine inspection surveys is likely to bring autonomy to the forefront of environmental survey work in the future.

In a third successful project, SAMS extended their work on pipelines to include optimising environment outcomes. The work is published within the Marine Scotland National Marine Plan Interactive GIS portal.

4.3 Innovative Monitoring

Innovative monitoring supported a range of projects that utilised novel sampling, modelling and synthesis of data. The following three have proven to be very successful and have had a direct impact on the industry:

Newcastle University developed a low cost marine mammal monitoring system. The system is ideal for both baseline studies and mitigation. A cost effective, low power, acoustically networked underwater monitoring system was developed. This incorporated broad spectrum click and whistle/call detection algorithms. The system was deployed in Northumberland coastal waters in support of wind farm activities and has proven effective in providing real time data during the period of COVID-19 lockdown.

Leeds University worked with BEIS to investigate the effectiveness of the current Environmental Emissions Monitoring System (EEMS). Instrumented aircraft were utilised to collect data to support a top down analysis of emissions that also utilised novel numerical modelling techniques. Leeds are preparing a report on the project for dissemination via OGUK.

SAMS developed a methodology for estimating marine growth using 3D photogrammetry from low cost cameras. The system was tested dockside during the project and a best practice guide developed for ROV surveys. Following completion of the project, the industry partner deployed the technology to support decommissioning activities in Thailand.

5. Recommendations

5.1 Programme Management

- Review mix of members early to missing target organisation types .
- Trade organisations representing operators and service companies to be included as members.
- Sustained efforts to engage existing and potential new members during the programme
- Annual review of industry needs in a rapidly changing energy world.
- Appointment of a project coordinator earlier in the life of the programme to help delivery.
- Greater transparency in funds expended within the programme to improve member confidence.
- Simplify outline proposals to reduce overhead burden of application and review process.
- Consider a mechanism to include funding to industry partners within the project framework.

5.2 Projects

- Requirement to demonstrate TRL of science/technology at bid stage and proposed TRL at end of the project to ensure it falls within the scope as a proven concept.
- Greater scrutiny of whether the timescales of funding can be met given the scope of a project.
- Webinar at project award to outline requirements of innovation funding, highlighting any differences to other funding mechanisms.
- Regular review meetings with industry partners to be mandated in innovation projects to allow a more agile management approach.
- A clear path to commercialisation should be required as part of the project submission, identifying the partner that would commercialise the project.
- Greater scrutiny of the IP arrangements within the final project proposals to ensure that this has been adequately addressed.
- Follow-on funding to support transition through the valley of death for promising projects.
- Greater scrutiny of capital costs to ensure hardware is obtained in the most cost-effective manner, such as rental rather than purchase for short term demonstration projects.

5.3 Industry/NERC Science engagement

- NERC establish relationships with OGUK and IOGP to understand and support industry needs.
- Recognition of other funding routes, such as the OGTC, which funds high TRL technologies.
- Dialogue with OGTC may be a way to bridge the valley of death for NERC science.
- NERC to recognise the oil and gas industry's dramatically changing role in the energy transition.
- Promote brokerage events (science dissemination / industry needs) on a regular basis.
- Create a view of centres of excellence to allow industry to access academic expertise.

5.4 Channels for Dissemination

- NERC engage with the Marine Industries Group of the Marine Science Coordination Committee with aim of providing 'fit for purpose' science to promote UK business practice and governance.
- Develop case studies for dissemination via trade bodies and trade electronic media.
- Engage with trade shows to promote outcomes of NERC science to a broad community.
- Improve visibility of NERC science to the industry sector through engagement with trade bodies, offering subscription based keyword search to newly awarded NERC projects.
- There is potential for a 'roadmap' event to follow up and promote the survey work undertaken toward the end of IPOG by the coordinator.
- Utilise industry newsletters such as OceanBuzz to disseminate project outcomes.

Appendix A List of Papers generated by the projects

A.1 Decommissioning 1

Optimising decommissioning of oil and gas pipelines with respect to the commercial fishing sector on the UK continental shelf, SAMS

1. Rouse S, Hayes P, Wilding T (2018). Commercial fisheries losses arising from interactions with offshore pipelines and other oil and gas infrastructure and activities. ICES Journal of Marine Science, doi:10.1093/icesjms/fsy116.
2. Rouse, S., Hayes P, Wilding TA. (2017). Novel Fishing Data Layers to Assist Pipeline Decommissioning. Aberdeen: Decom News. Decom North Sea.
3. Sally Rouse, Peter Hayes, Ian M. Davies, Thomas A. Wilding, (2018). Offshore pipeline decommissioning: Scale and context.. Marine pollution bulletin, 129 (1), pp. 241-244
4. Rouse S, Kafas A, Hayes P, Wilding T, (2017). Development of data layers to show the fishing intensity associated with individual pipeline sections as an aid for decommissioning decision-making. Underwater Technology, 34 (4), 171-178
5. Rouse S, Kafas A, Catarino R, Peter H, (2018). Commercial fisheries interactions with oil and gas pipelines in the North Sea: considerations for decommissioning. ICES Journal of Marine Science, 75 (1), 279 - 286.

Automation of marine growth analysis for decommissioning offshore installations, University of Aberdeen

1. Gormley K, McLellan F, McCabe C, Hinton C, Ferris J, Kline D, Scott B. (2018) Automated Image Analysis of Offshore Infrastructure Marine Biofouling. Journal of Marine Science and Engineering 6 (1).

A.2 Decommissioning 2

An evidence-based approach for the effects of decommissioning options on Marine Protected Area conservation and ecosystem services (DECOM-MPA), University of Hull

1. Burdon D, Barnard S, Boyes S, Elliott, M (2018). Oil and gas infrastructure decommissioning in marine protected areas: System complexity, analysis and challenges. Marine Pollution Bulletin Vol. 135, 739-758

Strategic review of autonomous system capability for long-term decommissioning monitoring, SAMS

No publications

Advanced monitoring of marine infrastructure for decommissioning, NOC

1. Macreadie P et al. (2018), Eyes in the sea: Unlocking the mysteries of the ocean using industrial, remotely operated vehicles (ROVs)., The Science of the total environment, Vol 634, 1077-1091.
2. Fowler A et al (2018). Environmental benefits of leaving offshore infrastructure in the ocean, Frontiers in Ecology and the Environment 16(10).
3. Jones D et al (2019) Autonomous marine environmental monitoring: Application in decommissioned oil fields, Science of the Total Environment 668, 835-853.
4. McLean D et al (2018)Understanding the Global Scientific Value of Industry ROV Data, to Quantify Marine Ecology and Guide Offshore Decommissioning Strategies, Offshore Technology Conference Asia, Kuala Lumpur, Malaysia, 20-23 March.

Development of a strategic framework for the comparative assessment of pipeline decommissioning options: optimising environment and fishing interests, SAMS

1. Rouse S et al (2018) Offshore pipeline decommissioning: Scale and context., Marine pollution bulletin, Vol 129, 1, 241-244.
2. Rouse S et al (2020), Commercial fisheries losses arising from interactions with offshore pipelines and other oil and gas infrastructure and activities, ICES Journal of Marine Science Vol 77,.3, 1148-1156.
3. Lacey N and Hayes P (2019), Epifauna associated with subsea pipelines in the North Sea, ICES Journal of Marine Science,Vol 77,.3, 1137-1147.
4. Rouse S et al (2019), Benthic Conservation Features and Species Associated With Subsea Pipelines: Considerations for Decommissioning, Frontiers in Marine Science Vol 6.

A.3 Innovative Monitoring

Innovative Monitoring of offshore methane and hydrocarbons with miniature sensors and autonomy, NOC

No publications to date

Radar-model-fusion approach for high-resolution marine resource mapping (RAWMapping), NOC

No publications to date

Fibre-optic distributed Acoustic Sensor Technology for seismic MOnitoring During shale gas Extraction (FAST-MoDE) University of Bristol

1. Baird A et al (2019). Modelling of Fibre-optic DAS response to microseismic arrivals in Anisotropic media. 81st EAGE Conference and Exhibition 2019: Micro and Passive Seismic I European Association of Geoscientists and Engineers, EAGE.

Monitoring and forecasting avian collision risk at an operational offshore wind farm - BTO

1. Elizabeth Masden (2019). The importance of flight speed in collision risk models. Poster Conference on Wind Energy and Wildlife Impacts, CWW2019, Stirling.
2. Aonghais Cook (2019). Using seabird tracking data to more accurately assess collision risk. Poster Conference on Wind Energy and Wildlife Impacts, CWW2019, Stirling.

Note no links are available to these posters.

Discrimination of Sediment Type using Unmanned Aerial Vehicles (DST-UAV) – Swansea University

1. Fairley et al (2018). The use of unmanned aerial systems to map intertidal sediment. Remote Sensing **2018**, *10*, 1918.

Novel low-cost methods for marine mammal and environmental monitoring - Newcastle University

1. Lowes G et al (2019) Low Energy, Passive Acoustic Sensing for Wireless Underwater Monitoring Networks OCEANS 2019 MTS/IEEE SEATTLE, Seattle, WA, USA, 2019, pp. 1-9.

Demonstration of a comprehensive Approach to monitoring Emissions from Oil and Gas installations (AEOG) – Leeds University

1. Lee J et al (2018) Flow rate and source reservoir identification from airborne chemical sampling of the uncontrolled Elgin platform gas release Atmos. Meas. Tech., 11, 1725–1739, 2018

Measuring ADD Noise in TIdal Streams (MANTIS): Could Acoustic Deterrent Devices (ADDs) reduce risk of marine mammal collisions with tidal turbines? - SAMS

1. Hastie G (2017), Harbour seals avoid tidal turbine noise: Implications for collision risk. Journal of Applied Ecology. 2017; 55: 684– 693
2. Lepper, PA, (2019). Deployment of static underwater acoustic recorders in high tidal flow environments. The Journal of the Acoustical Society of America 146:4, 3018-3018

Development of a standardised marine mammal monitoring system for the tidal energy industry – University of St Andrews

1. Hastie G et al (2019). Automated detection and tracking of marine mammals: A novel sonar tool for monitoring effects of marine industry, Aquatic Conserv: Mar Freshw Ecosyst. 2019; 29(S1): 119– 130.
2. Gillespie D, Macaulay J (2019) Time of arrival difference estimation for narrow band high frequency echolocation clicks., The Journal of the Acoustical Society of America. 2019 Oct;146(4):EL387. DOI: 10.1121/1.5129678.

Improving marine growth estimates using 3D photogrammetry, SAMS

No publications to date