



# UK National Seabed Mapping Programme – Scoping Study

---

A Final Report for the Department of Business, Innovation and Skills (BIS) and for the Maritime and Coastguard Agency (MCA)

In partnership with The Crown Estate and the Department for Environment, Food and Rural Affairs (Defra)

**Eunomia Research and Consulting**  
**Centre for Environment, Fisheries and Aquaculture Science (Cefas)**

**30<sup>th</sup> March 2016**

Report for the Department for Business, Innovation and Skills (BIS)

Prepared by Eunomia Research & Consulting Ltd and Centre for  
Environment Fisheries and Aquaculture Science

Approved by



.....

Sam Taylor

(Project Director)

Eunomia Research & Consulting Ltd  
37 Queen Square  
Bristol  
BS1 4QS  
United Kingdom

Tel: +44 (0)117 9172250

Fax: +44 (0)8717 142942

Web: [www.eunomia.co.uk](http://www.eunomia.co.uk)

*Disclaimer*

Eunomia Research & Consulting has taken due care in the preparation of this report to ensure that all facts and analysis presented are as accurate as possible within the scope of the project. However no guarantee is provided in respect of the information presented, and Eunomia Research & Consulting is not responsible for decisions or actions taken on the basis of the content of this report.



# Executive Summary

---

---

## KEY FINDINGS

- The current value of the marine and maritime sector to the UK economy is over £11 billion and the value of the wider Blue Economy has been estimated to contribute over £51 billion to Gross Value Added (GVA). This could grow significantly if the UK improves its seabed mapping infrastructure.
- Almost all activity in the marine environment is supported by seabed mapping in one form or another, and it is estimated that approximately £120 million is spent on undertaking seabed mapping activity per annum.
- Approximately £101 million of this investment is procured by private sector organisations, with the Oil & Gas, Renewables and Telecommunications and Cables sectors being the largest procurers (excluding seismic exploration, pipeline inspections and ROV work). The public sector is estimated to spend approximately £19 million, predominantly via four main seabed mapping programmes.
- A UK national seabed mapping programme could increase the current levels of investment and generate a range of benefits for both private and public sectors, as has been the case in other countries. For example, INFOMAR in Ireland has forecasted substantial returns on investment to date, as can be seen in Section 3.4.2 of this report. Open access to increased quantity and quality of seabed mapping data via a national UK seabed mapping programme could lead to the development of new equipment and technologies, exports, job generation and other growth opportunities.

For this report, a number of potential delivery options for a UK national seabed mapping programme were considered and assessed. Two potential delivery options, alongside the baseline, have been developed and modelled in detail. These are summarised as:

- **Option 1: National Programme – Light:** A national programme where survey activities undertaken are focused on existing and new areas identified as being of significant need. The definition of significant need is likely to be based on areas which are identified by a national mapping organisation in collaboration with other bodies as commercially, environmentally and scientifically important and which are at risk of having duplicated surveying efforts conducted in them. It is assumed that these areas would be in addition to those which the UK has an obligation to map under the International Convention for the Safety of Life at Sea (SOLAS) for the purposes of navigational safety and other such obligations; and

- **Option 2: National Programme – Full:** A national programme where the survey activities undertaken are focused on all UK marine areas, not just those areas identified as being of significant need for commercial, environmental and scientific reasons and where the programme is needed to improve the coordination of activity.

For both options there would be an expectation that as benefits are realised and an evidence base for increased mapping activity is built up, the scope of the programme would expand with the end goal being to map the entire UK Continental Shelf (UKCS). This progressive model mirrors that seen in the formation of other successful national seabed mapping programmes such as INFOMAR and MAREANO.

- It is acknowledged that there will always be a need for additional surveying to take place, particularly from the private sector, when specific data will need to be gathered in a specified timeline that the national programme might not necessarily align itself with. It is proposed that in order to improve efficiency between private sector organisations commissioning survey work and the national programme, a financing facility could be setup whereby the national programme would contribute to some of the private sector costs on condition that the data collected is relevant to the national programme, it meets a defined standard and can be made openly accessible.
- Based on a conservative set of assumptions, the Net Present Value (NPV) analysis undertaken for each of these options over a period of 10 years, suggests that Option 1 is the preferred approach, yielding a best estimate of £104.4 million over 10 years<sup>1</sup> and a Benefit to Cost Ratio<sup>2</sup> (BCR) of 7.4:1. This compares to a best estimate of £74.2 million over 10 years for Option 2, with a BCR of 3.9:1.

The main advantages presented by a national UK seabed mapping programme are:

- Increase in the availability and improved dissemination of high quality, standardised, complete raw and processed data for existing and new areas of strategic interest, to be made available to all stakeholders. It is expected that under a national programme data will be managed more efficiently and effectively;
- Acceleration of activities (e.g. planning, licensing) and de-risking of potential investment due to the existence of better quality baseline data, thereby addressing market failures and reducing barriers to growth;

---

<sup>1</sup> The cost benefit analysis is modelled over a 10 year period, which is standard practice. However it should be noted that any national seabed mapping programme would be expected to continue to be a national asset for well beyond this modelling period.

<sup>2</sup> Benefit to cost ratio is the marginal benefit accruing to each additional £1 of cost incurred in the programme.

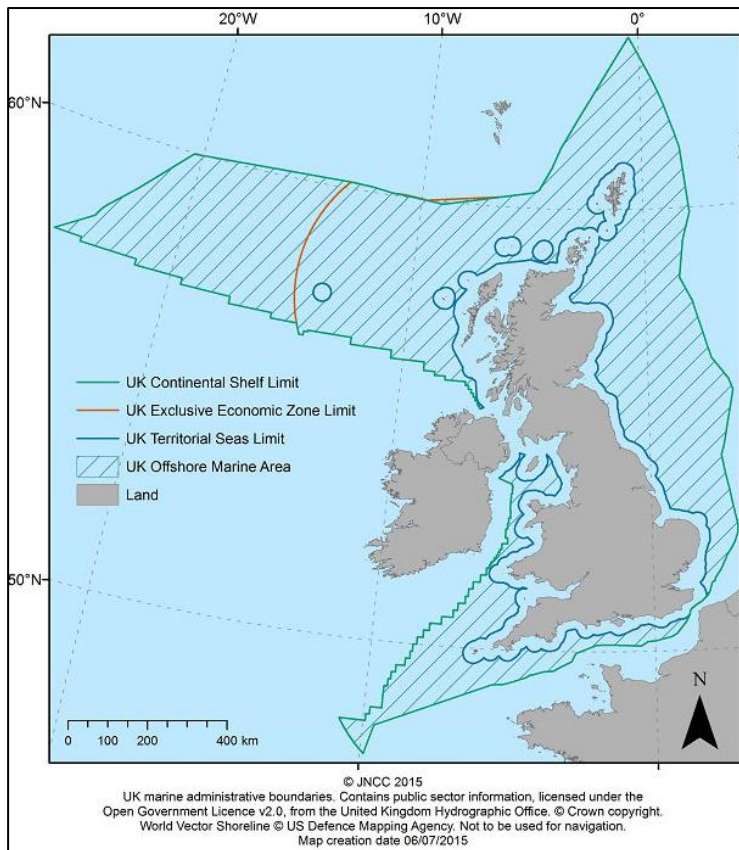
- Incentives for further integration of activities and the alignment of objectives among sectors and existing stakeholders during the procurement of services and technology for surveying and monitoring, resulting in efficiencies and cost reductions; Increased access and investment into research and innovation leading to 'value added' data and new marketable and exportable products and technologies such as Autonomous Underwater Vehicles (AUVs);
- Further improvements to coordination, communication and partnerships among stakeholders, including the public and private sectors, further improving efficiencies and reducing costs through collaborative working. Strong leadership from the private and public sectors working collaboratively together will be essential for progressing and driving forward a national seabed mapping programme;
- Generation of employment opportunities and acceleration of 'Blue Growth' for the marine & maritime industries; and
- Protection of marine ecology, generation of environmental benefits and prevention of environmental hazards.

## Executive Summary- introduction

---

The greater part of the UK lies under the sea, yet our knowledge of this area remains limited. It is estimated that only 30% of the UK seabed is currently mapped<sup>3</sup> using modern multi-beam echo sounder (MBES) equipment for hydrographic purposes. This number is even lower for derived map outputs such as geological or habitat maps. Figure E 1-1 summarises the UK Offshore Marine Area demonstrating the high proportion of UK territory that lies under the sea.

**Figure E 1-1: The UK Offshore Marine Area**



Source: Joint Nature Conservation Committee (JNCC) 2015

The marine and maritime sector contributes over £11 billion a year to the UK economy.<sup>4</sup> If the UK improves its seabed mapping infrastructure, this contribution could grow even

---

<sup>3</sup> North Sea Marine Cluster (NSMC)'s proposal for mapping the land under the sea (<http://www.gardline.com/news/article/226>)

<sup>4</sup> Department for Transport, 'Maritime Growth Study: keeping the UK competitive in a global market; Moving Britain Ahead', September 2015.



further through increased and accelerated business development in the marine environment and private and public sector spending efficiencies.

Data collection underpins almost all of the activities and the decisions made in the marine environment. However collecting data, particularly on the seabed, is expensive. Therefore, where there are opportunities to collect data, it should be completed in the most comprehensive and high quality method possible - ensuring that value for money is achieved.

The aim of this scoping study is to outline the key seabed mapping activities currently undertaken by the public and private sectors in the UK and to make recommendations regarding the economic and technological benefits that could arise from undertaking a nationally coordinated approach to seabed mapping.

In the context of this report, seabed mapping is defined as the activities undertaken to characterise the properties of the seabed in order to inform the work of UK Government and of the industries operating within the marine environment. This includes seabed mapping for hydrographic, geological and environmental purposes. The study has sought to build on existing attempts for further coordination and centralisation and on pockets of research already undertaken in the seabed mapping industry.

## E.1.0 Analysis and Key Findings

---

Using the findings of the research, a cost-benefit analysis was developed to quantify as far as possible the potential economic, technological and environmental benefits of a national programme. These were assessed against a counterfactual, which is the baseline scenario in which the status quo or 'business as usual' occurs.

Whilst there is a clear difference of views between different stakeholders on the precise detail of a national programme, there were some common criteria that a programme should include. These can be summarised as follows:

### **Where and What to Survey**

- Avoid unnecessary duplication of survey effort between public sector, and where possible private sector operators.
- The data needs of all stakeholders should be considered, be it bathymetric, environmental, geological or biological.
- Recognise that bespoke seabed mapping surveys will always be needed, but even so data should be collected to a common standard in order to maximise re-use.

### **How to Survey**

- Procure a range of equipment, technologies and services, to satisfy varied data needs.
- Data should be collected to a common agreed standard in order to maximise re-use.



## Access to the Survey Data

- Open sharing of data and resources.
- Provide a central database that would collate the survey data already collected across the public and private sectors.

Following this assessment, several delivery options for a national seabed mapping programme were considered. These options were assessed and most were eventually discounted due to a number of reasons, as outlined in detail in Section 5.4. Two potential delivery options alongside the baseline were developed in detail. These two options can be summarised as:

1. **Option 1: National Programme – Light:** A national programme coordinated by a single organisation or a partnership of organisations (or even a newly created body with combined staff from various interested parties), and the survey activities undertaken are focused on existing and new areas identified as being of significant need. The definition of significant need is likely to be based on areas which are identified by a national mapping organisation in collaboration with other bodies as commercially, environmentally and scientifically important and which are at risk of having duplicated surveying efforts conducted in them. It is assumed that these areas would be in addition to those which the UK has an obligation to map under the International Convention for the Safety of Life at Sea (SOLAS) for the purposes of navigational safety and other such obligations; and
2. **Option 2: National Programme – Full:** A national programme where the survey activities undertaken are focused on all UK marine areas, not just those areas identified as being of significant need for commercial, environmental and scientific reasons and where the programme is needed to improve the coordination of activity.

For both options there would be an expectation that as benefits are realised and an evidence base for increased mapping activity is built up, the scope of the programme would expand with the end goal being to map the entire UK Continental Shelf. This progressive model mirrors that seen in the formation of other successful national seabed mapping programmes such as INFOMAR and MAREANO.

Table E 1-1 provides a summary outline of the different features of each option considered, including the baseline.

**Table E 1-1: Summary of Options for Seabed Mapping Programme**

Theme	Activity	Baseline	Option 1- Light	Option 2 – Full
<b>Coordination</b>	Front-end coordination of survey activity	Conducted on an ad-hoc basis	Only existing and new areas identified as being of significant need i.e. identified as commercially, environmentally and scientifically important and where a significant risk of surveying duplication exist	All surveying activity
	Back-end coordination of data sharing	Some coordination, but largely limited to signatories of the MoU	All data shared	All data shared
<b>Governance</b>	Organisation responsible for mapping activity	Multiple organisations	A single national mapping organisation, with support from other organisations or a partnership of organisations	A single national mapping organisation, with support from other organisations or a partnership of organisations
<b>Interaction with Private Sector and</b>	Declaration of mapping priorities	Not uniformly announced	Will be announced by national mapping organisation	Will be announced by national mapping organisation

Theme	Activity	Baseline	Option 1- Light	Option 2 – Full
<b>other interested parties</b>	Interaction between public and private mapping	Isolated occurrences	<p>Will be recommended by national mapping organisation</p> <p>Incentives for improving interaction can also be explored such as setting up a financing facility whereby the national programme would contribute to some of the private sector survey costs on condition that the data collected is relevant to the national programme, it meets a defined standard and can be made openly accessible</p>	<p>Will be recommended by national mapping organisation</p> <p>Incentives for improving interaction can also be explored such as setting up a financing facility whereby the national programme would contribute to some of the private sector survey costs on condition that the data collected is relevant to the national programme, it meets a defined standard and can be made openly accessible</p>
	Availability of current data	Some data released publically	All data released publically.	All data released publically.
<b>Technology and Data</b>	Use of the latest available technology	Only where requested by individual organisations	Will only be deviated from by exception	Will only be deviated from by exception
	Use of Common Data Standards	Collected in different standards	Collected to a common standard	Collected to a common standard



In order to appraise each of the options a cost benefit analysis was conducted. The cost benefit analysis is modelled over a 10 year period, which is standard practice. However it should be noted that any national seabed mapping programme would be expected to continue to be a national asset for well beyond this modelling period. It should be noted that the economic contribution of a national seabed mapping programme against the backdrop of pre-existing surveying taking place has not been undertaken previously. In fact other reports evaluating existing programmes such as the PwC report on INFOMAR (2013)<sup>5</sup>, have assumed a backdrop of no pre-existing seabed mapping surveying.

There are forecast to be a range of administrative and economic impacts associated with the development of both of the proposed options for UK national mapping programmes, based on a review of secondary data and stakeholder interviews undertaken. These impacts include administrative savings as well as economic savings such as the creation of jobs and investment in research and development. However, not all of the impacts can be reliably quantified due to the dearth of information and data relating to existing seabed mapping activity; especially its full range of benefits.

The administrative impacts quantified include those relating to the need for additional coordination and scoping of seabed mapping activities, procurement of seabed mapping activities and data management. For Option 1, the total 10 year administrative costs is forecast to be £2.4 million (NPV), whilst the total 10 year administrative costs is forecast to be £4.8 million (NPV) for Option 2.

Alongside the administrative costs, significant economic benefits are forecast due to the expectation that a national programme will reduce the overlap of surveying effort and will enable better coordinated surveying to take place. These benefits are associated with the delivery of the programme rather than with the final impacts of the programme. During the course of the interviews, no organisation could provide a clear identification of precisely how much expenditure on surveying might be saved by the introduction of a national programme through avoided duplication of surveying or through the new or accelerated development of business opportunities. Therefore, in the absence of this evidence, conservative estimates for each of the options have been provided. These have been based on an interpretation of the interviews and assessment of the introduction of other national programmes.

Importantly, following the improved coordination of survey activity we expect a number of derived impacts to take place. These are:

- **Additional survey data.** For each of the options, the avoidance of duplication is expected to release resources to undertake additional surveying. This activity will generate new survey data – be that in new areas, and/or using different techniques;
- **Increased quality of survey data.** The use of common standards is expected to raise the quality of data generated by the national programme. Thus the data will be able

---

<sup>5</sup> PwC, 'INFOMAR - External Evaluation', 6 January 2013, [http://www.infomar.ie/documents/2013\\_PwC\\_Infomar\\_Evaluation\\_Final.pdf](http://www.infomar.ie/documents/2013_PwC_Infomar_Evaluation_Final.pdf).

to be used and reused for a variety of purposes to develop new products and services; and

- **Improved dissemination of survey data.** Increasing the availability of survey data is expected to further aid the development of new products and services.

Based on a conservative set of assumptions, the analysis undertaken for each of these options over a period of 10 years suggests that Option 1 is the preferred approach, yielding a best estimate of benefits of £104.4 million over 10 years (NPV) and a BCR of 7.4:1 (ranging from 1.1 for the low impact scenario to 8.25:1 for the high impact scenario).

This compares to a best estimate of £74.2 million (NPV) over 10 years for Option 2, with a BCR of 3.9:1 (ranging from 1.1 for the low impact scenario to 4.56:1 for the high impact scenario).

To place these figures in context, it is estimated that approximately £120 million is spent on seabed mapping per year in the UK. It is not known what the economic benefit associated with this effort is forecast to be, but studies of other national programmes estimate a BCR of approximately 1:10 and 1:13. Assuming the UK currently achieves a BCR of 1:10, approximately £1.2 billion of economic benefit is achieved each year. Therefore the introduction of a national seabed mapping programme would represent a modest saving over the 10 year period.

Beyond the economic savings, a number of unquantified impacts were also identified in the assessment. These include:

- improved dissemination of raw survey data;
- reduced barriers to growth;
- further opportunities for public-private partnerships;
- competition and employment impacts;
- increased access and investment into research and innovation;
- protection of marine ecology; and
- prevention of environmental hazards.

Whilst these impacts have not been quantified, they should not be diminished. To demonstrate some of these potential unquantifiable benefits, past evaluation reports have attempted to evaluate the potential full-economy impacts of other national programmes, such as PwC's 2008 report on Ireland's INFOMAR.<sup>6</sup> To do so, PwC evaluated the potential impacts of the INFOMAR programme on sectors which the programme had the capacity to support. The report concluded that Ireland's INFOMAR programme has impacted commercial and public sector players in a number of fields, either directly through value-added research or indirectly through data availability. These sectors include renewable energy, energy exploration, fishing, aquaculture, biodiversity, tourism, aggregates industry, research and legislation.

---

<sup>6</sup> PwC, 'INFOMAR Marine Mapping Study - Options Appraisal Report: Final Report', 30 June 2008, [http://www.infomar.ie/documents/INFOMAR%20Options%20Appraisal%20Report\\_PwC.pdf](http://www.infomar.ie/documents/INFOMAR%20Options%20Appraisal%20Report_PwC.pdf).

Over the most recent period, many of the maritime sectors in the UK have come under pressure to reduce costs. For example, the Oil & Gas sector has been impacted by lower oil prices and expenditure on seabed mapping is now lower than in previous years. Thus, it is critical that the seabed information is gathered effectively, efficiently and transparently. Based on the experience in other countries, a national seabed mapping programme would likely enhance the ability to deliver high quality seabed mapping data. This is expected to be delivered at an overall lower cost and help showcase technologies the sector is investing in that aim to reduce costs and increase efficiencies associated with mapping surveys, thereby maximising the potential for growth opportunities.

## E.2.0 Conclusions and Recommendations

---

The research has identified that there is a clear need and appetite for a national seabed mapping programme. Most importantly a national programme could lead to increased data sharing and reduce the unnecessary duplication and improved coordination of survey activities commissioned by both the public and private sectors, which was considered to be one of the key advantages of a national approach to seabed mapping.

The research has shown that a national programme can be effective and successful. Both MAREANO (Norway) and INFOMAR (Ireland) are considered to be examples of successful national programmes that have yielded invaluable information to their Governments and a range of maritime sectors; helping improve navigational safety, accelerate offshore development and contribute to national economies. Furthermore, both programmes have provided wider benefits to society, and have contributed to the public awareness of marine issues and to legislative reforms.

Whilst there are already significant benefits to existing seabed mapping activity, new and better quality data can deliver numerous additional benefits to the UK maritime economy. The increased availability of high quality public data could de-risk private investment, reducing the cost of borrowing and open up new areas of financing. It could contribute to and accelerate Blue Growth,<sup>7</sup> the EU's long term strategy to support sustainable growth in the marine and maritime sectors. As identified in other national seabed mapping programmes, a UK seabed mapping programme could also be used to leverage in European funding and provide a test-bed for research and innovation. Growth in this area is particularly important to the UK maritime economy.

Significant societal and environmental impacts could be derived from a national seabed mapping programme. Improved coordination and access of seabed mapping data could also be used to underpin flood and coastal erosion mapping and contribute to existing efforts undertaken by the Government in these areas. It could be used to support the implementation of the Marine and Coastal Act 2009 and the EU Habitats Directive, along with a range of other marine national and European legislation.

---

<sup>7</sup> European Commission (2014) *Maritime Affairs - Policy: Blue Growth*, accessed 18 June 2015, [http://ec.europa.eu/maritimeaffairs/policy/blue\\_growth/](http://ec.europa.eu/maritimeaffairs/policy/blue_growth/)



Furthermore a national programme could help showcase technologies in the field of marine robotics such as Autonomous Underwater Vehicles (AUVs), for which the UK is already a leader in technological design and development. These technologies have the potential to significantly reduce the costs and risks associated with survey activities while maximising efficiencies and increasing the amount of data collected through a single survey. The Oil & Gas industry has heavily invested in this area of research and development in recent years, due to the marketable and exportable nature of such technologies. A national programme would be the ideal platform to promote these technologies, leading to exports, growth and the attraction of further funding in research and innovation.

The research undertaken as part of this scoping study suggests that Option 1 (i.e. a national programme focusing on existing and new priority areas only) would be the preferred approach, yielding a total economic benefit over 10 years of £104.4m (NPV). This compares to a slightly smaller total economic benefit over 10 years of £74.2m (NPV) for Option 2.

In both options, the benefits are forecast to fall on both the private and public sectors. Private sector organisations commissioning seabed mapping activity concentrated in the Oil & Gas, Offshore Renewables and Telecommunications and Cables sectors are forecast to benefit from avoided duplication and increased access to a greater quantity of high quality data that can be used to inform or accelerate business development.

Option 1 would essentially entail a transition from the way activities are currently undertaken in the seabed mapping sector towards a more coordinated programme, where decision making will be centrally made, yet the focus of the activity will be exclusively focussed on existing or new areas which will provide most value and return on investment (i.e. where the potential for the greatest duplication might occur and which are identified by a national mapping organisation in collaboration with other bodies as commercially, environmentally or scientifically important). These areas may have already been identified as priorities for surveying, or may be identified as such in the future. Through improved coordination and communication amongst stakeholders, it will become easier to align objectives and requirements across various stakeholders in the planning stages of surveys, which can help form strong partnerships between public and private sectors to reduce survey costs and avoid the unnecessary duplication of survey activity (primary impacts). Furthermore, this option will require that all survey activities abide by specific standards which will improve the quality of data being collected and maximise re-use. New and better quality data can lead to reduced navigational and investment risks, reduced loss of equipment and gear and environmental and innovation benefits through the development of marketable and exportable products and technologies, etc. (derived impacts).

The model is based on the key assumption that any tangible public sector savings achieved by the programme in respect of primary impacts are reinvested into the programme in order to deliver the derived impacts. Although this assumption may not always be strictly followed in practice, it was a necessary inference to make in order for the model to be able to deliver any kind of savings. It should be noted that this assumption does not apply to any private sector savings achieved by the programme due to the fact that the private sector has no incentive to undertake further survey work beyond their needs. Instead, the assumption is that the private sector will realise direct savings to the cost of their business activities. The possibility exists that as benefits are realised and an evidence base for increased mapping activity is built up, the scope of the programme under Option 1 will expand with the end goal being to map the entire UK Continental Shelf (UKCS), as was the case with MAREANO.

Furthermore, the additional data being collected will facilitate development of industries such as aquaculture, aggregates, fisheries, cables/pipelines, port approaches and offshore renewables, as was the case with INFOMAR.

It is acknowledged that there will always be a need for additional surveying to take place, particularly from the private sector, when specific data will need to be gathered in a specified timeline that the national programme might not necessarily align itself with. It is proposed that in order to improve efficiency between private sector organisations commissioning survey work and the national programme, one of the features of the national programme could be a financing facility whereby the national programme would contribute to some of the private sector costs on condition that the data collected is relevant to the national programme, it meets a defined standard and can be made openly accessible.

Another potential condition of claiming finance could be that private sector organisations must share information about any upcoming survey plans. Open communication and transparency can improve coordination between the private sector and the national programme, increasing access to data for all stakeholders and potentially reducing duplication of effort even further. The level at which organisations can claim finance and the period of time during which such claims can be made by the surveyor will need to be determined if such a fund is setup, to ensure that the surveyors have an incentive to claim finance (i.e. that the amount of money being reclaimed does reduce the cost the surveyor would have incurred to undertake more survey work) and that the data being shared by the private sector is still relatively recent and thereby relevant for wider use. The financing facility will also contribute to data management to help make any data received from the private sector widely available, and any applications made for claiming finance will need to include a data management plan.

The main advantages presented by Option 1 are:

- Increase in the availability of high quality, consistent, complete data for existing and new areas of strategic interest, which will be made available to all stakeholders;
- Acceleration of activities (e.g. planning, licensing) and de-risking of potential investment due to the existence of better quality baseline data;
- Incentives for further integration of activities and alignment of objectives among sectors and existing stakeholders during the procurement of services and technology for surveying and monitoring;
- An ability to leverage in EU funding, including funding focussed on research and development;
- Further improved coordination and partnerships among stakeholders; and
- A lower capital and operational cost outlay than that required by Option 2.

The evidence presented in this scoping study suggests that progressing the recommended option for a national seabed mapping programme will first require the relevant public and private sector organisations and industries to come together, assess the findings of this scoping study and agree to work collaboratively to:

1. Consolidate existing public sector mapping programmes under a new, authoritative body;

2. Ensure that, where possible, seabed survey activities collect data on all parameters of national interest (bathymetry, geology, hydrology, biology) and to a consistent standard;
3. Consolidate existing data management activities into one coherent activity; and
4. Explore options for encouraging or incentivising private sector surveyors for seabed survey work that is collected and shared in accordance and coordination with the public sector programme.

As stated in Section 7.1.2, any initiative that leads to a national coordinated programme would require options for increased funding to be explored from public, private and external sources.

The immediate next step should be building on the work undertaken in this scoping study and developing a detailed business plan for this delivery option. The business plan will need to explore in more detail:

- the extent of the potential for duplication of surveying activities;
- the scope of the national programme, including how it will be managed and funded, including an option for a fund for private sector cost recovery;
- how the data will be managed and funded ;
- what variables will feature in the decision-making framework for prioritisation of areas to map, and how that prioritisation will take place;
- a time-plan for the activities;
- an identification of the stakeholders that will need to be involved in the decision-making process;
- what the consultation process will be e.g. via four stakeholder meeting groups a year (one every quarter); and
- options for which organisation or partnership of organisations would be best suited to lead the programme, or perhaps if a new body with combined staff from various interested parties will need to be created.

Once a detailed framework of the national programme has been outlined, it will be necessary for the business plan to also seek to establish, in quantitative terms, the programme's funding requirements on an annual basis and how these costs can be met. The assumptions in the model will need to be critically tested, including those assumptions relating the overlap of surveying effort.

Additionally, the governance structure and framework for a national programme will also need to be considered further. It is evident that a number of partnerships and collaborative working is already undertaken by a range of organisations involved with seabed mapping. In order for the national programme to succeed, a national programme will be required to build on this experience and provide a coherent framework for the management and delivery of seabed mapping in the UK. Strong leadership from the private and public sectors working collaboratively together will be essential for progressing and driving forward a national seabed mapping programme.

While some coordination already exists among the public and private sectors separately, there is scope to further expand coordination and communication between the two. Improved coordination would help deliver efficiencies in undertaking seabed mapping

activities and reduce costs. Depending on the programme delivery mechanism, such partnerships can be encouraged at several stages:

1. **Programme Design:** partnerships at the consultation stage can help align objectives and requirements for surveying, thereby jointly determining what types of data are needed and what the areas for mapping should be. One survey will therefore have the potential to satisfy many data needs;
2. **Programme Development:** through partnerships there can be a combination of available resources (such as survey equipment and vessels) and knowledge (such as existing databases), thereby increasing efficiencies and decreasing costs. Note however that this precludes commercially or strategically sensitive resources; and
3. **Programme Delivery:** Through partnerships there can be a system of continued consultation, and thereby open access to the outputs and data resulting from the surveys. Improving access to data can yield benefits for marine planning, business investment, the marine environment and navigational safety.

Finally the business plan should also propose Key Performance Indicators (KPIs) that would be used to evaluate the success of the national programme. These KPIs will need to relate to the resourcing of the programme (e.g. total annual spend, net annual spend, annual operating spend, etc.), its inputs (e.g. staff levels, total vessel days, profile of capital assets, etc.), its outputs (e.g. total square kilometres area mapped, locations mapped at sea, number of identified publications from data, additional funding or additional number of projects per year due to data delivered by programme, etc.) and its outcomes (e.g. feedback from key stakeholders, levels of public/private data users, significant project developments, etc.).

# Glossary of Terms

---

Acronym	Meaning
AFBI	Agri-Food and Biosciences Institute
AUV	Autonomous Underwater Vehicles
BGS	British Geological Survey
BIS	Department for Business, Innovation and Skills
BMAPA	British Marine Aggregate Producers Association
CCO	Channel Coastal Observatory
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CHP	Civil Hydrography Programme
DAC	Data Archive Centre
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food & Rural Affairs
EA	Environment Agency
EIA	Environmental Impact Assessment
EUNIS	European Nature Information System
IFCA	Inshore Fisheries and Conservation Authorities
GVA	Gross Value Added
IHO	International Hydrographic Organisation
IMO	International Maritime Organisation
INFOMAR	Integrated Mapping For the Sustainable Development of Ireland's Marine Resource
INSS	The Irish National Seabed Survey
JNCC	Joint Natural Conservation Committee
MAREA	Marine Aggregate Regional Environmental Assessment

<b>Acronym</b>	<b>Meaning</b>
<b>MAREANO</b>	Marine Area Database for Norwegian Waters
<b>MAREMAP</b>	Maritime Environment Mapping Programme
<b>MARPOL</b>	Marine Pollution Convention
<b>MBA-DASSH</b>	Marine Biological Association Data Archive for Marine Species and Habitat Data
<b>MBES</b>	Multi-Beam Echo-Sounder
<b>MCA</b>	Maritime and Coastguard Agency
<b>MEDIN</b>	Marine Environmental Data and Information Network
<b>MMO</b>	Marine Management Organisation
<b>MoD</b>	Ministry of Defence
<b>MoU</b>	Memorandum of Understanding
<b>MPA</b>	Marine Protected Areas
<b>MPAG</b>	MPA Survey Co-ordination and Evidence Delivery Group
<b>NE</b>	Natural England
<b>NERC</b>	Natural Environment Research Council
<b>NOC</b>	National Oceanography Centre
<b>NPV</b>	Net Present Value
<b>NRW</b>	Natural Resources Wales (formerly Countryside Council of Wales)
<b>PSEG</b>	Productive Seas Evidence Group
<b>RSMP</b>	Regional Seabed Monitoring Plans
<b>SAMS</b>	Scottish Association for Marine Science
<b>SNH</b>	Scottish Natural Heritage
<b>SOLAS</b>	International Convention for the Safety of Life at Sea
<b>SSS</b>	Side Scan Sonar
<b>UKCS</b>	United Kingdom Continental Shelf

<b>Acronym</b>	<b>Meaning</b>
<b>UKHO</b>	United Kingdom Hydrographic Office
<b>UKMMAS</b>	UK Marine Monitoring and Assessment Strategy
<b>UNCLOS</b>	United Nations Convention on the Law of the Sea
<b>WFD</b>	Water Framework Directive



# Contents

---

<b>1.0</b>	<b>Introduction.....</b>	<b>1</b>
1.1	Aims and Objectives .....	3
1.2	Structure of the Report .....	4
<b>2.0</b>	<b>Methodology .....</b>	<b>5</b>
2.1	Task 1: Document and Appraisal of Existing Seabed Mapping Activities.....	5
2.2	Task 2: Review of Scope for Accessing and Sharing Industry Datasets.....	6
2.3	Task 3: Undertake Interviews with Key Stakeholders .....	7
2.4	Task 4: Examine Options for Financing a National Programme .....	8
2.5	Task 5: Develop and Apply a Cost-Benefit Model .....	9
2.5.1	<i>Identification of Key Stakeholders and Impacts for Modelling.....</i>	<i>10</i>
2.5.2	<i>Types of Economic Impact .....</i>	<i>11</i>
2.5.3	<i>Construction of the Economic Model.....</i>	<i>13</i>
<b>3.0</b>	<b>Overview of Current Seabed Mapping Activities .....</b>	<b>15</b>
3.1	Public Sector Programmes.....	18
3.1.1	<i>Main Seabed Mapping Programmes .....</i>	<i>18</i>
3.1.2	<i>Noteworthy Seabed Mapping Programmes .....</i>	<i>31</i>
3.1.3	<i>Other Programmes / Data Users .....</i>	<i>36</i>
3.2	Private Sector Programmes and Activities .....	37
3.2.1	<i>Marine Aggregates Regional Seabed Monitoring Plans.....</i>	<i>38</i>
3.2.2	<i>Transatlantic Telecommunication Cable Survey.....</i>	<i>40</i>
3.2.3	<i>Offshore Renewables Industry .....</i>	<i>41</i>
3.2.4	<i>Oil &amp; Gas Industry .....</i>	<i>43</i>
3.3	Common Themes Across all Seabed Mapping Programmes.....	45
3.3.1	<i>Overlap in Survey Areas .....</i>	<i>45</i>
3.3.2	<i>Data Management.....</i>	<i>46</i>
3.4	Management of Other National Programmes .....	49
3.4.1	<i>MAREANO (Norway).....</i>	<i>50</i>
3.4.2	<i>INFOMAR (Ireland).....</i>	<i>51</i>
3.4.3	<i>Pacific Regional Hydrography Survey and Maritime Charting Initiative (New Zealand).....</i>	<i>55</i>
<b>4.0</b>	<b>A UK National Seabed Mapping Programme .....</b>	<b>56</b>
4.1	Public Sector Interviewees .....	57

4.2	Private Sector Interviewees.....	62
<b>5.0</b>	<b>Options for a National Seabed Mapping Programme .....</b>	<b>69</b>
5.1	Baseline: Maintain Status Quo .....	72
5.2	Option 1: National Programme - Light .....	72
5.3	Option 2: National Programme - Full .....	75
5.4	Proposed Options Considered and Discounted .....	78
<b>6.0</b>	<b>Economic Assessment of National Programmes.....</b>	<b>80</b>
6.1	Baseline Assessment.....	80
6.1.1	<i>Quantifying the Baseline.....</i>	<i>81</i>
6.1.2	<i>Forecast of the Baseline Scenario .....</i>	<i>85</i>
6.2	Cost and Benefits of the Options.....	86
6.2.1	<i>Identification of Impacts .....</i>	<i>87</i>
6.2.2	<i>Quantification of the Administrative Impacts .....</i>	<i>88</i>
6.2.3	<i>Economic Impacts .....</i>	<i>91</i>
6.2.4	<i>Summary of Quantified Impacts .....</i>	<i>94</i>
6.2.5	<i>Sensitivity Analysis.....</i>	<i>96</i>
6.2.6	<i>Unquantified Impacts.....</i>	<i>98</i>
<b>7.0</b>	<b>Conclusions and Recommendations .....</b>	<b>104</b>
7.1	Development of the National Programme.....	107
7.1.1	<i>Programme Management .....</i>	<i>107</i>
7.1.2	<i>Financing Options .....</i>	<i>107</i>
7.1.3	<i>Data Management.....</i>	<i>114</i>
7.2	Opportunities and Benefits .....	115
7.3	Risks and Challenges.....	116
7.4	Suggested Next Steps .....	116
<b>A.1.0</b>	<b>Appendix 1: Interview Topic Guide .....</b>	<b>119</b>
<b>A.2.0</b>	<b>Appendix 2: Interview Contact List .....</b>	<b>126</b>
<b>A.3.0</b>	<b>Appendix 3: Cost-Benefit Assumptions .....</b>	<b>129</b>

# 1.0 Introduction

---

Eunomia Research & Consulting (Eunomia) in collaboration with the Centre for Environment, Fisheries and Aquaculture Science (Cefas) are pleased to present this report to the Department for Business, Innovation and Skills (BIS) in partnership with the Maritime and Coastguard Agency (MCA), The Crown Estate and the Department for the Environment, Food and Rural Affairs (Defra), on a scoping study for a UK national seabed mapping programme.

The greater part of the UK lies under the sea– the UK’s exclusive economic zone (EEZ) is around 760,000 square km - yet our knowledge of this area remains limited.<sup>8</sup> The UK has a marine and maritime sector (to include marine engineering and manufacturing, shipping, ports and maritime professional business services) which employs over 113,000 people and generates at least £11 billion to the UK economy,<sup>9</sup> which is forecast to increase to £25 billion by 2020.<sup>10</sup> The value of the wider Blue Economy, which includes marine and maritime, energy and mineral resource, leisure, defence and transport, has been estimated to be worth over £51 billion in direct Gross Value Added (GVA) supporting over 900,000 jobs.<sup>11</sup> This economy could grow even further through increased business opportunities and private and public spending efficiencies if the UK improves its seabed mapping database.

Data collection underpins almost all of the activities and the decisions made in the marine environment. However collecting data, particularly on the seabed, is expensive. Therefore, where there are opportunities to collect data, it should be completed in the most comprehensive, high quality method possible - ensuring that value for money is achieved by aiming to collect data once that can be used many times.

Currently there are a number of public and private sector bodies engaged in mapping of UK waters, which collectively are responsible for 2-3% of newly surveyed seabed each year. The UK’s main and only systematic mapping programme is conducted by the MCA’s Civil Hydrography Programme (CHP) for navigational safety. It is estimated that only 30% of the UK seabed is currently mapped<sup>12</sup> using modern multi-beam echo sounder (MBES) equipment for hydrographic purposes. This number is even lower for derived map outputs

---

<sup>8</sup> <http://www.seararoundus.org/data/#/eez/826?chart=catch-chart&dimension=taxon&measure=tonnage&limit=10>

<sup>9</sup> Department for Transport, ‘Maritime Growth Study: Keeping the UK Competitive in a Global Market - Moving Britain Ahead’, September 2015.

<sup>10</sup> UK Marine Industries Alliance, ‘A Strategy for Growth for the UK Marine Industries’, 19 September 2011, [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/31813/11-1310-strategy-for-growth-uk-marine-industries.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/31813/11-1310-strategy-for-growth-uk-marine-industries.pdf)

<sup>11</sup> Marine Southeast, *The Blue Economy in the UK: revitalisation and further opportunities*, June 2015

<sup>12</sup> North Sea Marine Cluster (NSMC)’s proposal for mapping the land under the sea (<http://www.gardline.com/news/article/226>)

such as geological or habitat maps. This was reiterated in a 2010 report published by Cefas<sup>13</sup> which concluded that:

*“the seabed habitat data currently available is too sparse, patchy and variable in quality to make sound decisions in relation to key planning and management processes.”*

It is anticipated that mapping 100% of the UK seabed would take decades if seabed mapping activities continue to be conducted in a disjointed manner.

The drivers for mapping often differ between the sectors and the stakeholders within each sector, resulting in the same area sometimes being mapped several times over to varying specifications. Examples include the Channel Coastal Observatory (CCO) survey along the northern shores of the Isle of Wight, which only collected bathymetry data, and was resurveyed as part of the Marine Protected Areas (MPA) Evidence Programme in order to obtain backscatter data. Similarly, an area surveyed south of Start Point by Cefas on behalf of Natural England for habitat mapping purposes did not have sufficient sounding density to meet the CHP specifications, and as a result was resurveyed by CHP contractors.

Examples such as these can lead to an unnecessary duplication of effort and resources. Increasing the amount of comprehensive quality seabed mapping data would potentially reduce costs and uncertainty to the industry, particularly in the early planning stages of development projects, and would represent an opportunity for jobs and growth in the UK economy.

A greater level of coordination in both organising mapping activities and sharing the outputs of mapping efforts could potentially yield benefits for public sector efficiencies, planning, business growth, the environment and safety. Consequently there has been a growing recognition of the benefits of increased coordination and many efforts have been taken already, particularly by the public sector, to share data. However, there is still room for improvement by building on the existing efforts taken.

The public sector has some initiatives in place which encourage the sharing of data. However, data is frequently only published after completion of surveys, allowing for duplication of seabed mapping efforts to still occur. Furthermore, the private sector has also coordinated some seabed mapping activity through the development of industry specific databases (e.g. oil and gas, aggregates). However, access to this data is not made widely available due to confidentiality and commercial concerns and there is a risk of unnecessary duplication of seabed mapping effort. A national programme could help address these concerns, to an extent, although it will likely not replace all existing activities nor completely remove the need for re-mapping the same areas repeatedly (such as for example for any offshore development which will require a site investigation prior to construction to satisfy risk and insurance concerns).

---

<sup>13</sup> Cefas and ABPmer, 'ME5408: Marine Survey Needs to Underpin Defra Policy - Final Report', July 2010, [http://www.oceandtm.com/ME5408\\_Marine\\_Survey\\_Needs\\_Final\\_Report.pdf](http://www.oceandtm.com/ME5408_Marine_Survey_Needs_Final_Report.pdf)

## 1.1 Aims and Objectives

The aim of this scoping study is to outline the key seabed mapping activities currently undertaken by the public and private sectors and to recommend what economic and technological benefits there could be from undertaking a nationally coordinated approach to seabed mapping.

This scoping study has sought to build on those attempts for further coordination and centralisation and its findings will be used to determine whether a national programme would be the best way forward for the industry. It builds on pockets of research already undertaken in the seabed mapping industry, such as the Financial Benefits of Hydrographic Survey evaluation report published by Anatec Ltd on behalf of the MCA (2010)<sup>14</sup>, as well as the Review of Access to Industry Marine Environmental Data report published by ABP Marine Environmental Research and Peter Barham Environmental on behalf of the Productive Seas Evidence Group (2015).<sup>15</sup>

To achieve this aim, the requirements of governmental and private sector organisations in relation to bathymetric, environmental, biological and geological data sets have been examined. Through the use of interviews, maritime professional bodies and private sector organisations involved in seabed mapping activities have been consulted to capture views on how a national programme might lead to the development of technology, skills and value added data of possible products and services.

The scope of the project has focussed mainly on outlining and reviewing major seabed mapping projects using modern multi-beam echo sounder (MBES) technology. MBES technology is the predominant form of equipment used in modern day seabed mapping activities (whereas currently single-beam technology is only used in low budget localised projects). MBES technology would therefore be the preferred equipment for a national programme. That is not to say that a national seabed mapping programme would be limited to just MBES data. On the contrary it is likely that under the national programme MBES data would be supplemented with ground-truthing data and other data types, for which existing methods and procedures are in place for wider use by the different stakeholders.

Within the terms of reference of the study there have been a number of specific objectives, which have been addressed in this report. These included:

- Documenting the seabed mapping work already underway and planned, in the private and public sectors in the UK, as well as a few noteworthy programmes outside the UK. This included how surveys are undertaken, how the information is used, its accessibility and its impact economically, socially and environmentally;
- Explaining what types and methods of seabed mapping data would bring the most benefits to businesses and what areas of the seabed should be prioritised, as well as

---

<sup>14</sup> Anatec Ltd, 'Financial Benefits of the Civil Hydrography Programme' (Maritime Coastguard Agency, 23 June 2010).

<sup>15</sup> Productive Seas Evidence Group, ABP Marine Environmental Research Ltd, and Peter Barham Environmental Ltd, 'A Review of Access to Industry Marine Environmental Data', December 2015.

to provide recommendations on how the programme could be centrally managed effectively;

- Ascertaining and quantifying the advantages, both financial and in terms of quality and versatility of data, to the public sector of having one coordinated national seabed mapping programme that would incorporate, compliment or replace multiple existing programmes;
- Outlining options for financing a national programme and what criteria would need to be fulfilled to improve the chances of qualifying for this;
- Suggesting how the data will be stored and shared and then exploring issues around data ownership and access. This included an assessment of what technology and equipment would be needed to carry out the mapping and the potential for developing (and subsequently exporting) new marine products and technologies; and
- Costing benefits so that the programme can deliver the right kind of data that will benefit British businesses, marine manufacturing industries and wider society.

## 1.2 Structure of the Report

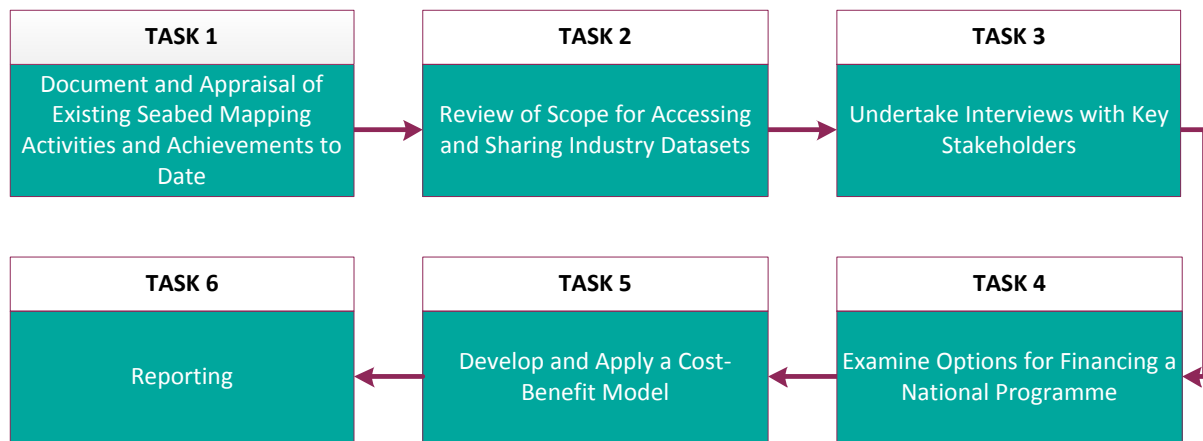
The report is structured as follows:

- Section 2.0 provides a detailed overview of the methodology used to undertake the study;
- Section 3.0 provides an overview of the current seabed mapping activities and related coordination programmes in the private and public sectors, including a review of the available data and the scope for accessing and sharing industry datasets for the purpose of a national programme;
- Section 4.0 presents the outcomes of interviews with private and public sector stakeholders in respect of a UK national seabed mapping programme;
- Section 5.0 presents the options for a UK national seabed mapping programme;
- Section 6.0 outlines the baseline scenario for the cost benefit model and provides an assessment and quantification of the business, economic, technological and other costs and benefits of a national programme; and
- Section 7.0 presents the conclusions and recommendations for a national seabed mapping programme, including options for financing it, how it could be managed and how it could be effectively coordinated with other existing data libraries.

## 2.0 Methodology

The approach to undertaking the scoping study has been undertaken in a six stage process, as shown in Figure 2-1.

**Figure 2-1: Overview of Key Tasks**



These tasks are discussed in detail in the following sub-sections.

### 2.1 Task 1: Document and Appraisal of Existing Seabed Mapping Activities

Task 1 has documented and appraised existing seabed mapping programmes across the UK's private and public sectors via a literature review. In order to organise the research a framework was developed for:

1. identifying the types of information to be captured; and
2. classifying the information and data derived from the literature review.

In conducting the task existing literature was reviewed, including data from industry datasets such as the Marine Environmental Data and Information Network (MEDIN)<sup>16</sup> and the UK Marine Environmental Mapping Programme (MAREMAP).<sup>17</sup>

The framework developed focused on the following main types of mapping uses:

- Bathymetric;
- Environmental;
- Geological; and
- Biological.

For each type of mapping use, the existing survey programmes were documented using a logic model approach. For each programme the following information was captured:

<sup>16</sup> British Geological Survey, 'BGS MEDIN Data Archive Centre', 2015, <http://www.bgs.ac.uk/services/NGDC/management/marine/MEDINDataArchiveCentre.html>.

<sup>17</sup> British Geological Survey et al., 'Marine Environmental Mapping Programme (MAREMAP)', 2015, <http://www.maremap.ac.uk/view/information/about.html>.



- Context:
  - Name;
  - Lead organisation;
  - How the work is undertaken;
  - Major funding sources;
  - Budget for undertaking the work;
  - Geographical scope;
  - Frequency of activity;
  - Priority areas for surveying;
  - Motivation for doing the work;
  - Coordination with other existing seabed mapping programmes and/or databases; and
  - Whether the programme is public or private.
- Inputs and Processes:
  - Methods and equipment for surveying;
  - Type of data captured;
  - Information on vessels used; and
  - Number of staff involved in designing and in undertaking the surveys.
- Outputs:
  - Noteworthy achievements;
  - Main products, services and technologies;
  - Main data outputs;
  - Data impacts (economic, social and environmental); and
  - Data management (accessibility, storage, sharing, budget).
- Planned activities in the near future (next five to 10 years).

## 2.2 Task 2: Review of Scope for Accessing and Sharing Industry Datasets

Building on the logic model developed under Task 1, Task 2 focused on reviewing the scope for accessing and sharing existing industry datasets, with the final aim being to potentially consolidate these under a national programme. The focus has been on data access and sharing, as well as on storage options and associated budgets for seabed mapping information.

Using the data gathered from both tasks, a comprehensive summary overview of existing and planned seabed mapping activities in the UK has been provided, which outlines what areas of the seabed tend to be prioritised for mapping and what types and methods of seabed mapping data are easily accessible, leading to the greatest impacts. This summary overview includes a review of how other national programmes such as INFOMAR (Ireland)<sup>18</sup>,<sup>19, 20</sup> and MAREANO (Norway)<sup>21</sup> and the Pacific Regional Hydrography Survey and Maritime

---

<sup>18</sup> INFOMAR, 'Integrated Mapping for the Sustainable Development of Ireland's Marine Resource', accessed 17 June 2015, <http://www.infomar.ie/about/>.

<sup>19</sup> PwC, 'INFOMAR Marine Mapping Study - Options Appraisal Report: Final Report'.

<sup>20</sup> PwC, 'INFOMAR - External Evaluation'.

Charting Initiative (New Zealand)<sup>22</sup> have been managed to establish the most effective way of centrally managing a UK programme. It also includes whether there has been any duplication in survey areas across the public and private sectors, and if so, where and why.

## 2.3 Task 3: Undertake Interviews with Key Stakeholders

To supplement the desk-based review undertaken as part of Tasks 1 and 2, interviews with key stakeholders in the seabed mapping sector were undertaken, spanning the public and private sectors. The full list of stakeholders approached for interviews can be found in Appendix A.2.0.

Interviewees were sent 'topic guides', containing the themes due to be explored in advance of the interviews. This helped to familiarise participants with the topic matter and inform the discussion. The interviews adopted a semi-structured approach and provided an in-depth assessment - lasting on average for 45 minutes each.

Interviewees were asked to provide their views on three themes:

- Seabed mapping activities: current and planned;
- Approach to seabed mapping data management; and
- Scope, risks and benefits of a national seabed mapping programme.

The full interview topic guide can be found in Appendix A.1.0.

In most instances interviews were recorded (after being granted permission by the interviewee) to ensure detailed transcripts of the discussions were captured that could be revisited, where necessary. Following the interview most interviewees were also asked clarification questions on specific discussion points.

The information provided by the interviewees on current and planned seabed mapping activities and approach to data management have been used to supplement the findings from Tasks 1 and 2.

The views of the interviewees on the national seabed mapping programme have been used to inform the assumptions made for the cost-benefit model, in terms of establishing its scope, benefits and opportunities (including main beneficiaries in terms of sectors and/or specific organisations) and risks and challenges. The scope covered whether there's a need for a national programme, potential sources of funding, options for management, what priorities, equipment and technologies would be needed and the main outputs it will be expected to deliver.

---

<sup>21</sup> 'MAREANO - Collecting Marine Knowledge', accessed 17 June 2015, [http://www.mareano.no/en/about\\_mareano](http://www.mareano.no/en/about_mareano).

<sup>22</sup> Secretariat of the Pacific Community and New Zealand Ministry of Foreign Affairs and Trade Aid Programme, 'Assessing the Costs and Benefits of Hydrographic Survey and Charting - A Case Study of Vanuatu', accessed 17 June 2015, [http://www.iho.int/iho\\_pubs/misc/M\\_2\\_Suppldocs/2014-SPC-Vanuatu\\_Hydrographic\\_Survey-Cost\\_Benefit\\_Analysis.pdf](http://www.iho.int/iho_pubs/misc/M_2_Suppldocs/2014-SPC-Vanuatu_Hydrographic_Survey-Cost_Benefit_Analysis.pdf).

## 2.4 Task 4: Examine Options for Financing a National Programme

Using the findings from Tasks 1, 2 and 3, two potential delivery options for a UK national seabed mapping programme were developed. For each of these options the scope, needs and objectives of a national programme, its potential benefits and constraints, as well as potential financing options have been outlined. All of these findings were then used to develop and run the cost-benefit model. The approach taken is described in more detail in the following sub-sections.

### Step 1: Derive Generic Delivery Options for a UK National Seabed Mapping Programme

Using the findings from Tasks 1, 2 and 3, two generic delivery options for a national programme were determined and agreed upon alongside the option of maintaining the status quo (the baseline). These options were selected based on the specific objectives of a UK national seabed mapping programme as outlined in the specification for the study. The options are summarised as follows:

- Baseline: Maintain Status Quo;
- Option 1: National Seabed Mapping Programme – Light; focusing on areas of seabed mapping activity with potential duplication; and
- Option 2: National Seabed Mapping Programme – Full; focusing on all seabed mapping activity.

Each of these options is further detailed in Section 5.0.

### Step 2: Assess Needs and Objectives for a UK National Seabed Mapping Programme

Following the derivation of the two delivery options and the baseline using the findings from Tasks 1, 2 and 3, the potential needs and objectives of such a programme were established. This included identifying the existing market failures in the UK, establishing the legislative and regulatory framework, identifying marine resource information requirements and discussing what contributions such a national programme could make to the knowledge economy, businesses, marine manufacturing industries and the wider society.

### Step 3: Assess Benefits and Constraints for a UK National Seabed Mapping Programme

Any potential constraints that a national programme might encounter were also identified. This included the availability of funding mechanisms on national and European levels, as well as the availability of the required skills, vessels, equipment and technology to operate.

Furthermore issues surrounding data management were also considered; this included data ownership, access, budgets and storage. The review also sought to identify any previous unsuccessful attempts for a national programme over the last ten years, and if so, what the limitations encountered were.

### Step 4: Refine Delivery Options for a UK National Seabed Mapping Programme

For each of the delivery models described under Step 1 alongside the baseline, a framework was established to consider the needs and objectives of, as well as the constraints faced by a UK national seabed mapping programme. This included:

- the roles and responsibilities amongst key stakeholders;
- the types of seabed mapping data needed and potential conflicts among these;
- the types of technology and equipment needed to cover bathymetric, environmental and geological mapping, including vessels;
- the methods for capturing seabed mapping data, including how the surveys will be undertaken, how to choose and prepare a suitable Geographic Information System (GIS), relevant research and other activities;
- how to effectively co-ordinate with and support existing UK data libraries such as MEDIN and MAREMAP;
- options for data acquisition and management to include data storing, sharing, ownership, access and public availability;
- the potential for developing and exporting new products, technologies and services for UK and non-UK markets; and
- any other relevant information.

On the basis of these considerations, the advantages and disadvantages of each delivery option, as well as the key stakeholders and profile of costs arising in each, were outlined. The detail of this exercise is provided in Section 5.0.

### Step 5: Identify Financing Options

Available public and public/private finance initiatives for developing, implementing and maintaining a national seabed mapping programme in the UK were identified, including programmes available from the European Commission. Furthermore the information gathered as part of Tasks 1-3 on how other national seabed mapping programmes have been managed and funded (such as INFOMAR, MAREANO and the Pacific Regional Hydrography Survey and Maritime Charting Initiative) were referred to.

### Step 6: Undertake a Risk Analysis

Finally the risks which may potentially affect the successful implementation of a national programme and the securing of its maximum benefits were considered for each of the delivery options.

## 2.5 Task 5: Develop and Apply a Cost-Benefit Model

Alongside the identification and assessment of the options for the national programme, an assessment of the relative costs and benefits of each of the options has also been considered.

Given the widely accepted difficulty associated with an estimation of the economic impact of data to the wider economy and stakeholders, the model considers impacts associated with the delivery options accruing only to key public and private stakeholders identified as those who are currently and regularly actively involved in existing seabed mapping programmes (i.e. those highlighted in Section 3.0).

The key impacts assessed and quantified have been categorised as:

- **Economic Impacts:** includes the value of the goods and services supplied by seabed mapping activity; and

- **Administrative Impacts**<sup>23</sup>: includes economic impacts relating to the planning and delivery of seabed mapping activity (such as the generation of jobs or investment in research and development) rather than with the final impacts of the programme.

Where the quantification of key impacts (notably: environmental impacts, competition impacts and impetus for innovation in the market, and the multiplier effect associated with new knowledge/ skills) was not possible, in the interest of robust and relevant findings, these have been addressed qualitatively alongside modelled findings. Previous studies have attempted to evaluate some of these unquantified impacts such as the PwC 2008 report on Ireland's INFOMAR<sup>24</sup>, which is described in more detail in Section 3.4.2.

All costs and benefits have been estimated over a ten year period as is standard practice with cost benefit analysis, from 2016/17 through 2025/26 and are expressed as the Net Present Value (NPV) for the period. A discount rate of 3.5% was used to calculate NPV in line with the HM Treasury Green Book (HM Treasury, 2011).<sup>25</sup> All costs and benefits, irrespective of the year to which they are related, are expressed in real 2015 terms, using GDP deflators as outlined in HM Treasury Blue Book.<sup>26</sup> It should be noted however that any national seabed mapping programme would be expected to continue to be a national asset for well beyond this modelling period.

### 2.5.1 Identification of Key Stakeholders and Impacts for Modelling

The model considers impacts associated with the delivery options accruing only to key public and private stakeholders, identified as those who are involved in significant existing seabed mapping programmes (i.e. those highlighted in Section 3.0). These include:

- **Key partners and sponsors in long-term recurring public sector programmes** including the Civil Hydrography Programme (CHP), the Regional Coastal Monitoring Programmes of England, the Marine Environmental Mapping Programme (MAREMAP) and the Marine Protected Areas (MPA) Evidence Programme;
- **Key partners and sponsors in fixed term or one-off public sector programmes**, including programmes under the Welsh Government, DECC, the Marine Management Organisation (MMO) and The Crown Estate; and
- **Survey contractors** such as Gardline and Fugro and private sector organisations, including business and trade associations undertaking seabed mapping for the

---

<sup>23</sup> It is noted that administrative impacts are already included within the baseline annual cost/ budget figures for each existing delivery option, as they are an economic impact and because limited information regarding the break-up of these costs among economic and administrative activities was available. However, for the purposes of this assessment, administrative impacts have been calculated separately from the economic impacts using the Standard Cost Model – it is therefore assumed that the economic growth rates associated with the programme options do not include administrative impacts, allowing the avoidance of double counting in the aggregation of the economic 'outcome' and the administrative impact together.

<sup>24</sup> PwC, 'INFOMAR Marine Mapping Study - Options Appraisal Report: Final Report'.

<sup>25</sup> H.M Treasury, 'The Green Book: Appraisal and Evaluation in Central Government', 2011.

<sup>26</sup> H.M. Treasury, 'GDP deflators at market prices, and money GDP: October 2015 (The Blue Book)', 2015.

Telecommunications (Cables), Aggregates, Oil & Gas and Offshore Renewables industries.

The full list of stakeholders identified under each of these programmes is provided in Appendix A.2.0. While there are hundreds of organisations involved in seabed mapping activities or using seabed mapping data in some capacity, for the purposes of the cost benefit assessment, the stakeholders considered have been limited to those organisations which are currently regularly and actively involved in surveying the seabed and using relevant seabed mapping data, across the public and private sectors.

### **2.5.2 Types of Economic Impact**

For the sample of stakeholders highlighted above, the individual cost/benefit impacts modelled under each broad category (i.e. administrative and economic) are described in detail in Table 2-1.

It is important to note that the model is based on the key assumption that any public sector savings achieved by the programme in respect of primary economic impacts are reinvested into the programme in order to deliver the derived impacts associated with additional seabed mapping data – a key outcome for the programme. It should be noted that this assumption does not apply to any private sector savings achieved by the programme due to the fact that the private sector has no incentive to undertake further survey work beyond their needs. Instead, the assumption is that the private sector will realise direct savings to the cost of their business activities.

Impacts are achieved only relative to the baseline vis-à-vis budgetary spending that would have been required under the status quo no longer being necessary, due to the reduced duplication of effort and higher level of coordination accomplished under either option. As a result, the unspent funds are freed up for deployment in added seabed mapping activity that would not have been undertaken in the baseline scenario. The benefits of this additional investment and the outputs arising therefrom (both in terms of additional and better quality information being made available to all stakeholders) are then captured as the derived benefits of the programme.

**Table 2-1: Schedule of Costs/ Benefits Modelled**

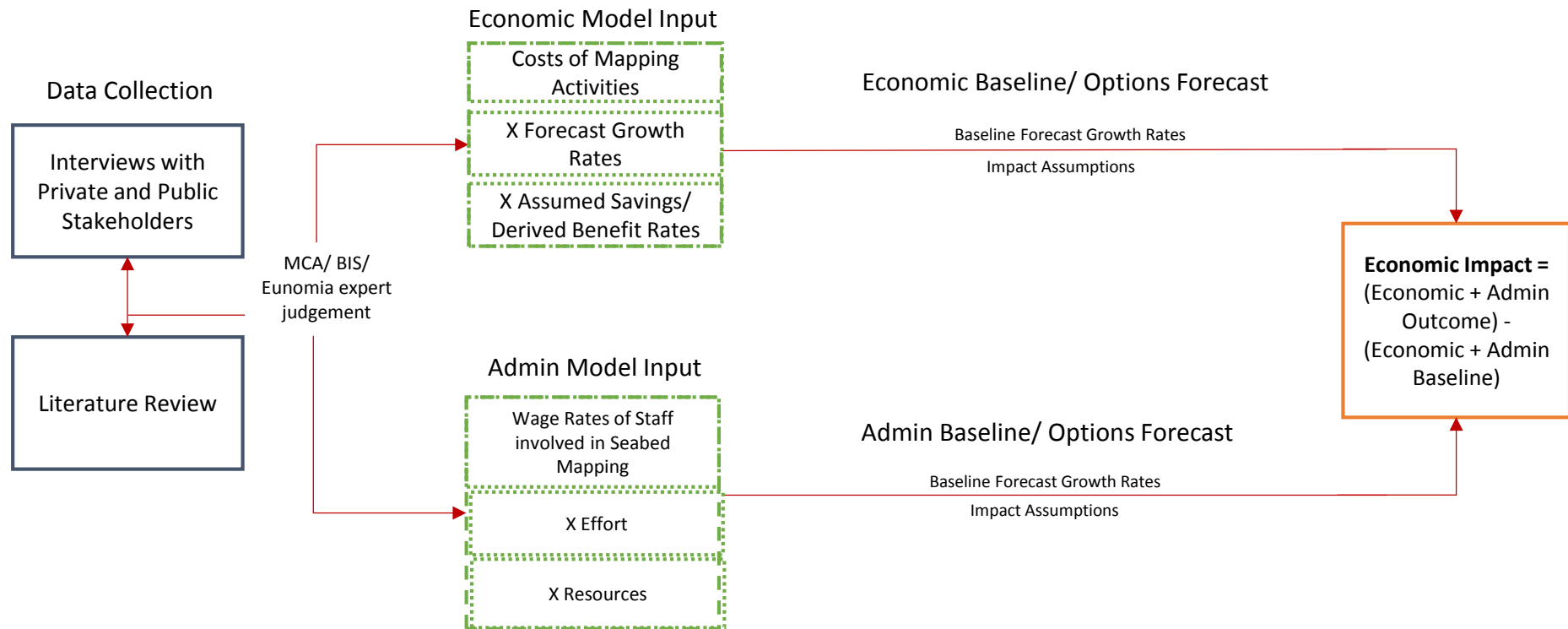
Category	Sub-category	Cost/Benefit Activity	Description
Administrative	Coordination and Scoping	Coordination	Organisational effort across all relevant public authorities towards cost-efficient deployment of resources for mapping, including providing/accessing data to/from other organisations.
		Identification of Priority Areas for Mapping	Public sector effort associated with selection and application of a prioritisation methodology to identify areas of the UKCS with the significant need/value for additional survey effort.
		Determination/ Consultation	The identification of areas of significant need for mapping through evaluation and consultation with public and private sector stakeholders.
	Procurement	Procurement Process	Back of office effort associated with identification of contracts for public procurement, and undertaking of procurement activities.
		Contract Management	Effort associated with the management of contracts following the tender evaluation procedure.
	Data Management	Data Access and Storage	Management and consolidation of the core data archive centres, including implementation of data clause, open licensing etc.
		Formatting and Validation	Establishment of a set format and standard for metadata, as well as implementation of quality assurance procedures for validating datasets and outputs.
	Economic	Primary Impact	Avoided Duplication of Effort
Investment in additional surveying activity			The savings resulting from the avoided duplication of effort will be reinvested in additional surveying activity. Thus additional data, than otherwise will be collected as part of the programme.
Derived Impact		Benefits of Programme Outputs	Benefits of wider access to data, access to better quality data and access to new data e.g. new or accelerated business development in the marine environment, de-risking of business development in the marine environment, increased safety, navigational efficiency, reduced hazards from equipment/ gear loss, groundings, pollution, etc.

### **2.5.3 Construction of the Economic Model**

The methodology for assessment of the economic impacts is shown diagrammatically in Figure 2-2.



**Figure 2-2: Methodology for the Assessment of the Economic Impacts**



Source: Eunomia Research & Consulting Ltd

## 3.0 Overview of Current Seabed Mapping Activities

---

This section describes the key current and planned seabed mapping programmes across the UK public and private sectors following on from research undertaken as part of Tasks 1, 2 and 3.

Table 3-1 presents an overview of the various seabed mapping programmes currently in operation in the UK across the private and public sectors, either with a hydrographic, geological or environmental focus, and the types of data being collected. This review and assessment, as previously mentioned, has only considered major projects using MBES. MBES is the predominant form of equipment used in modern day seabed mapping activities (whereas currently single-beam technology is only used in low budget localised projects) and would therefore be the preferred equipment for a national programme.

In the following sub-sections a detailed description of each of the programmes is included for the public and private sectors. Additionally, an overview of the common themes between the programmes is presented alongside an overview of other relevant national seabed mapping programmes.

**Table 3-1: Main Current UK Seabed Mapping Programmes and Data Types**

Programme	Multi-beam (MBES)	Single beam	Side-scan	Seismic (sub-bottom)	Water column data	Sediment sampling	Biological sampling	Video/ ROV observations	Topographic Lidar <sup>27</sup>
<b>PUBLIC SECTOR</b>									
Maritime & Coastguard Agency's (MCA) Civil Hydrography Programme (CHP)	X	O			O	X			
Channel Coastal Observatory's (CCO) Regional Coastal Monitoring Programmes	X	O			O	X		O	X
Environment Agency's (EA) Regional Coastal Monitoring Programmes	O	O			O	X		O	X
British Geological Survey (BGS) Marine Environmental Mapping Programme	X		O	O		X		O	
National Oceanography Centre (NOC) Marine Environmental Mapping Programme	O		O	O	O	X	X	X	O
Scottish Association for Marine Science (SAMS) Marine Environmental Mapping Programme	X		X		O	X	X		

---

<sup>27</sup> For seabed mapping of intertidal environments

Programme	Multi-beam (MBES)	Single beam	Side-scan	Seismic (sub-bottom)	Water column data	Sediment sampling	Biological sampling	Video/ ROV observations	Topographic Lidar <sup>27</sup>
<b>PUBLIC SECTOR</b>									
Marine Protected Areas (MPA) Evidence Programme	X		O			X	X	X	
Department of Energy and Climate Change (DECC)	O		O		X	X	X		
Northern Ireland Department of the Environment (DOE)	X		X			X	X	X	
Marine Scotland	X		X	X	X	O	O		
<b>PRIVATE SECTOR</b>									
Marine Aggregates	X		O	X		X	X		
Oil and Gas	X		X	X		X	X	X	
Wind/ Offshore renewables	X		X	X	X	O	O	O	
Cables and Pipelines	X					X			

*X: Regular collection during surveys. O: Limited collection during surveys.*

## 3.1 Public Sector Programmes

This Section describes the current public sector seabed mapping programmes in the UK. For ease of classification, the public sector programmes have been categorised as per the descriptions provided in Table 3-2.

**Table 3-2: Outline of UK Seabed Mapping Programmes**

Classification	Description
<b>Main Programmes</b>	Seabed mapping programmes which are typically ongoing. The programmes have been operational for a significant amount of time and benefit from consistent funding, often addressing a regulatory need.
<b>Noteworthy Programmes</b>	Seabed mapping programmes which are typically one-off and commissioned based on needs at a specific point in time.
<b>Other Programmes / Data Users</b>	Programmes under organisations which typically may not commission or undertake seabed mapping surveys directly, but which make extensive use of marine and seabed mapping data to fulfil their roles and requirements

For each of the programmes the following information is summarised:

- Programme Overview;
- Programme Inputs and Processes;
- Programme Outputs; and
- Planned Activities.

### 3.1.1 Main Seabed Mapping Programmes

#### 3.1.1.1 Civil Hydrographic Programme (CHP)

##### Programme Overview

The largest hydrographic and seabed mapping data collection programme in the UK is the Civil Hydrography Programme (CHP). This programme is government funded and led by the Maritime and Coastguard Agency (MCA) with data provided to the UK Hydrographic Office (UKHO).

The primary objective of this programme is to safeguard life at sea, producing accurate and up to date navigational charts. However, the CHP delivers benefits beyond just navigational safety. It also ensures that all surveys it carries out, or that it contracts to third parties, collect high-quality data to international standards (such as the International Hydrographic Organisation's (IHO) Order 1a). This ensures that data can be repeatedly used for many different purposes (e.g. that hydrographic data collected also constitutes reference bathymetric and environmental data, etc.). Aside from the data, the programme management expertise acquired over the many decades the CHP has

been running, the survey specifications developed by the MCA, as well as the robust contract management methodology, are all examples of best practice and of other assets delivered by the CHP, which are shared with the industry as appropriate.

The CHP is one of the mechanisms through which the UK complies with its hydrographic requirements under the International Convention for Safety of Life at Sea (SOLAS), which are to ensure that ships comply with minimum safety standards in construction, equipment and operation. The responsibility to comply with the SOLAS Convention is delegated to the Secretary of State for Transport in the UK who in turn delegates the responsibility for carrying out the hydrographic element of the work to the MCA.

The MCA own, fund and deliver the programme, while the UKHO provides technical support, validation and archive services through a zero-cost Memorandum of Understanding (MoU). The survey work is prioritised based on the remaining areas of greatest navigational risk to the mariner, using a GIS-based toolkit developed by the MCA. The toolkit has most recently identified that at least £50 million worth of high priority SOLAS surveys remain.

Funding is based on an ongoing programme with an annual baseline budget of £5.4 million per annum. In addition to the baseline budget, additional funding sources such as European funds have been sourced to perform additional work. Specifically in 2015-2016 an additional £1.2 million has been secured by MCA from other sources such as the EU-funded INTERREG IV-A programme, which brings the total survey budget to approximately £6.6 million. INTERREG, also known as the European Territorial Cooperation fund, is a financing instrument for the European Regional Development Fund (ERDF).<sup>28</sup> It has been running since 1990 with an increasing budget for each programme funding round. INTERREG IV ran from 2007-2013 and had a total budget of €8.7 billion. The programme was split onto three strands;

- IV A- Cross border cooperation;
- IV B – Transnational cooperation, included programmes such as the North Sea Programme<sup>29</sup> used to fund INFOMAR; and
- IV C – Interregional cooperation.

The £6.6 million has been spent solely on acquiring data through seabed surveys (i.e. bathymetry, backscatter, ground truthing, secchi disk, photography, etc.) and on analysis of that data (e.g. processing, interpreting, mapping, report writing, etc.). The MCA also bear additional costs for supporting the programme, in the order of £250,000 per year for administering, procurement, programme management, technical development and other costs such as staff salaries. For the UKHO, this additional cost is in the order of £350,000 per year and it's used to validate the data gathered by the CHP and to archive it in the Data Archive Centres (DAC).

---

<sup>28</sup> [http://ec.europa.eu/regional\\_policy/en/policy/cooperation/european-territorial/](http://ec.europa.eu/regional_policy/en/policy/cooperation/european-territorial/)

<sup>29</sup> <http://archive.northsearegion.eu/ivb/projects/>

The CHP's survey work is typically planned three to five years in advance, with survey priorities being re-assessed on an annual basis. MCA outsource most of the seabed mapping they undertake under the CHP to long-term commercial suppliers. The procurement round is undertaken once every five years, and currently, a full-time equivalent team of four at the MCA deliver the programme from a programme management and technical development perspective.

The MCA has also been successful in pushing cross-government collaborations through the CHP (such as with the Channel Coastal Observatory (CCO), Natural England (NE), Scottish Association for Marine Science (SAMS), CEFAS, etc.) that involve the sharing of survey data, survey specifications and other assets. All of the CHP's contractors collect seabed mapping data to international standards and to the CHP's survey specifications,<sup>30</sup> thus ensuring that this bathymetric data can be reused by different types of organisations many different times over. Furthermore, the MCA has successfully delivered two additional multi-million pound EU-funded INTERREG projects, which have the additional benefits of aligning the Irish INFOMAR programme with the CHP.

### **Programme Inputs and Processes**

Survey work undertaken for the CHP is almost exclusively focused on hydrographic data. It predominantly focusses on MBES data collection to generate a detailed understanding of the water depth and potential hazards. However, sediment samples are also collected through a companion programme of seabed sampling to determine seabed composition and water column data is collected for the delineation of particular navigational hazards such as wrecks and debris, as indicated by Table 3-1.

The CHP is also currently working with English Heritage to collect data on wrecks for their national monitoring. All MBES data collected within the CHP must meet minimum standards of the International Hydrographic Organisation (IHO) S44 Order 1a. This standard is intended for areas where the sea is sufficiently shallow to allow man-made or natural features to be of concern to surface shipping.

As part of the CHP backscatter data is also being collected, which is a product of MBES surveys commonly used for sediment surface classification and habitat mapping. In recent years backscatter requirements have been introduced in the CHP specification to maximise the wider use of the data being collected.

Survey work is typically the responsibility of third party contractors, with the MCA's team of seabed mapping experts and specialist programme managers responsible for identifying the priority areas to be surveyed, planning timescales and coordinating all survey activity to reduce the risk of duplication. Furthermore the MCA own and write the CHP survey specification for all survey contractors to follow and this is freely shared with

---

<sup>30</sup> Maritime & Coastguard Agency. 2013. UK Civil Hydrography Programme survey specification. Available [Online]

all organisations within the UK who collect hydrographic data (Maritime & Coastguard Agency, 2013).<sup>31</sup> Any data collected by contractors is reviewed by the MCA to ensure it is of high quality and it's then made freely available for re-use.

Finally, the MCA actively seek out third party funding to augment national funds and often deliver surveys directly on behalf of other government organisations. In 2013 the MCA awarded three survey companies the current round of five-year contracts for all CHP related work (Hydro International News, 2013).<sup>32</sup> These companies were: EGS for routine resurveys in navigationally critical areas, Gardline Geosurvey for shallow water surveys from 0-40m depth and MMT UK for shallow and medium water surveys from 0-200m depth. Each company possesses multiple vessels specifically equipped for providing marine surveys, operating on a 365 days per year basis. Various vessels from these contractors may be used for CHP surveys depending on their availability and site conditions. Vessels have the technical capability to work in a variety of conditions including shallow surveys and are crewed with specialist staff for acoustic surveying.

In addition to surveys commissioned by the MCA, data are gathered from other organisations to update navigational charts. MCA survey contracts cover European waters and permit any UK public sector organisation to commission work under them. Therefore any economies of scale introduced under the CHP ensure that partner organisations receive a high quality product at very competitive pricing.

Thirteen organisations<sup>33</sup> have signed a memorandum of understanding (MoU) between the MCA and Defra to share hydrographic survey data freely between signatories, to avoid survey efforts being repeated. This data is commonly used to support the CHP in areas where MCA surveys have not been planned.

### **Programme Outputs**

The programme delivers survey data that can be used for many different purposes as well as analysed to update navigational charts. Survey products of hydrography and sediment data are provided to the UKHO for the updating of navigational charts. The sale of navigational charts by the UKHO to an international market is a major source of revenue for the UKHO. Furthermore, the CHP delivers programme management expertise, survey specifications for collecting high-quality data and a bespoke contract management methodology, all of which are viewed as assets and programme

---

<sup>31</sup> Maritime & Coastguard Agency. 2013. UK Civil Hydrography Programme survey specification. Available Online [http://www.channelcoast.org/national/procurement/Specification\\_Bathymetry\\_CHP\\_2013.pdf](http://www.channelcoast.org/national/procurement/Specification_Bathymetry_CHP_2013.pdf) Accessed 15/12/2015.

<sup>32</sup> Hydro International News. 2013. New Contractors for UK Civil Hydrography Programme. Available [Online]. <http://www.hydro-international.com/content/article/new-contractors-for-uk-civil-hydrography-programme?output=pdf> Accessed 11/12/15.

<sup>33</sup> These are: MCA, Defra, UKHO, Agri-Food and Biosciences Institute (AFBI), BGS, CEFAS, Joint Nature Conservation Committee (JNCC), Marine Scotland, Ministry of Defence (MoD), Natural England (NE), Natural Resources Wales (NRW), Scottish Natural Heritage (SNH) and The Crown Estate.



deliverables. For example the MBES survey specification for attaining the IHO S44 Order 1a has led to an improvement in the quality of hydrographic data collected by a range of organisations.

All data collected during surveys are made publically accessible via the relevant data archiving centre (DAC) on MEDIN. The UKHO manages the bathymetric DAC with backscatter data sent to the BGS DAC.

This programme complies with the UK's obligations under SOLAS, which has benefits for the protection of human life through improved navigational safety and reduces the likelihood of an environmental disaster caused by a vessel accident. There are a number of non-SOLAS benefits as well, including increased efficiency of trade by sea and improved port access. In addition the data collected through the CHP has a number of secondary benefits and uses including: exploration and exploitation of marine resources; coastal zone management; environmental protection; marine science; maritime boundary delineation; marine defence; tourism; and recreational boating. The study commissioned by the MCA evaluated the total benefit of the CHP to be £72.3 million per year in 2010 (Anatec, 2010).<sup>34</sup>

### **Planned Activities**

The CHP underpins nearly all national survey efforts and as such, delivers great efficiency gains and high quality data that can be reused for many different purposes by different types of organisations. These and other benefits have been described in detail in the cost-benefit analysis commissioned by the MCA in 2010,<sup>35</sup> and as such the MCA has recently received approval to extend their long-term contracts with their suppliers under the CHP through to 2018.

### **3.1.1.2 Regional Coastal Monitoring Programmes of England**

#### **Programme Overview**

There are six Regional Coastal Monitoring Programmes of England that were created to inform local councils and governments regarding coastal management decisions. These regions are Northeast, Northwest, East Riding, Southwest and Southeast all of which are coordinated by the Channel Coastal Observatory (CCO), while the Anglia region is managed by the Environment Agency (EA).

The first regional programme was formed in the Southeast in 2002, with other programmes formed subsequently to cover the entire English coastline. Funding for the regional programmes is derived from Defra via the EA, based on five-year tranches. Phase 2 for the programme is due to commence in April of 2016 and is scheduled to run until 2021/2022.

---

<sup>34</sup>Anatec 2010. Financial benefits of the Civil Hydrography Programme. (Accessed 14/12/15)

<sup>35</sup>Ibid.

The regional programmes are responsible for ensuring the UK government meets its obligations under the Coastal Protection Act 1949. The primary area of interest for these programmes is between the mean low water contour until approximately one kilometre offshore. Survey work is typically undertaken to underpin flood and coastal erosion mapping, coastal management decisions and engineering and coastal development projects.<sup>36</sup> Each of the regional programmes sets the priorities for their work plan based on their own interests, and those of the region's local and county council authorities. Together the regional programmes make up the second largest bathymetric data collection programme within the public sector.

Due to shared interests in certain geographic areas, surveys are commonly run in collaboration with other organisations such as the MCA, BGS and the National Oceanography Centre (NOC). For example, in the past the CCO and the MCA have commissioned adjacent MBES surveys, with CCO surveys covering the nearshore waters and MCA surveys gathering data beyond this to create full coverage maps. Data collected in this way are beneficial for safety of life at sea and can be used to improve charts in shallow waters affecting both commercial and recreational uses, such as yachting.<sup>37</sup>

The EA are also involved in some seabed mapping work in the Anglia region of the Regional Coastal Monitoring Programme. Other work is particularly related to inshore coastal waters and some coastal development projects.

### **Programme Inputs and Processes**

These surveys are primarily focused on collecting bathymetric data, with hydrographic data (waves, currents and tides), and sediment samples typically considered of secondary interest. Specific projects may involve the use of bathymetry and sediment samples for a variety of purposes including modelling coastal schemes, wave transformation and the generation of habitat and geological maps. All MBES data collected within these programmes must meet minimum standards of the IHO S44 Order 1a. CCO and the EA commission contractors to carry out survey work on their behalf.<sup>38</sup> However, individual surveys may also be contracted to other government organisations such as the BGS, who have previously performed surveys in the coastal zone.

As the types of surveys vary both in their extent and purpose, the CCO and EA often use a variety of contracted vessels for different projects. Vessels contracted by the CCO and EA are typically small and capable of surveying the seabed up to the low tide mark. Depending on the projects and weather conditions, surveys may vary in length from a couple of days to entire months, with the staff levels required also varying widely.

---

<sup>36</sup> <http://www.channelcoast.org/>

<sup>37</sup> [http://www.channelcoast.org/national/procurement/Specification\\_Bathymetry\\_CHP\\_2013.pdf](http://www.channelcoast.org/national/procurement/Specification_Bathymetry_CHP_2013.pdf)

Accessed 15/12/2015.

<sup>38</sup> <http://www.channelcoast.org/national/procurement/>

The EA and CCO also commission the collection of LIDAR. While this is predominantly used to survey the intertidal zone and the land above the extreme high water springs, there is also some seabed area surveyed.

Once collected, bathymetry and substrate samples and water column data are used for a variety of applications. This includes modelling sediment transportation, sources of sediment and coastal erosion, as well as understanding the seabed habitat for local authority planning and advising on coastal development.

### **Programme Outputs**

The regional programmes report to a diverse range of local and regional government authorities. Quantifying the value of the data products and reports from the regional programmes is complex; however, the projects are typically in areas of high importance to local authorities and are used to inform policy and management.

As a signatory of the MoU on hydrographic data sharing, the CCO makes all data collected during surveys commissioned by the regional programmes widely available, free of charge. Bathymetry and sediment data are sent to the relevant DAC for storage and the CCO also makes all data available for download, free of charge, on their website. Due to quantity of seabed coverage of CCO data and high importance of many sites surveyed, there are many examples of how CCO data has provided additional benefits beyond the original purpose for collection. For example, all hydrographic data are used by the UKHO to improve navigational charts. BGS have also used CCO data for interpreting the geology in the land-sea interface, and to improve models of sediment stability.

While the EA makes all its data available on an Open Government Licence (OGL), as yet these data are not necessarily stored in relevant DACs, and in order to access it, it has to be requested directly from the EA. As such while the EA holds a wealth of LIDAR and other data, there is limited knowledge of what areas are currently covered.

## Case Study: Seabed Mapping and Coastal Protection

The National Network of Regional Coastal Monitoring Programmes of England collects seabed mapping data to inform coastal engineering and management. Mapping is undertaken to provide an inventory of base data as a foundation for further studies in shoreline change, sea level rise and as a basis for management decisions. The programme gathers multibeam echosounder data from about Mean Low Water Springs to approximately 1km offshore. Bathymetric surveys may be needed annually in areas of low tidal range and active submerged sediments e.g. Bournemouth (Dorset), whilst areas that have a beach toe that dries at low water on a hard rock platform will not benefit from frequent bathymetric surveys e.g. Hythe (Kent).



Bathymetry data off Hurst Spit, Solent. Credit: Channel Coastal Observatory.

The winter 2013-2014 storms had a major impact on coastal areas around the UK. At Chesil Beach, Dorset, large parts of the beach and seabed were eroded, undermining local sea defences. Sediment was found to be removed from the immediate beachfront, down to depths of 20 metres. Repeat surveys demonstrated that recovery was taking place and informed the coastal management strategy.

### Planned Activities

The next five-year tranche for the programmes is due to begin in 2016 and will run until 2021. The regional programmes will continue to set priorities for survey work individually in response to particular issues or planned developments.

#### 3.1.1.3 Marine Environmental Mapping Programme (MAREMAP)

##### Programme Overview

The Marine Environmental Mapping Programme (MAREMAP) is a joint initiative that began in 2010 and brings together many Natural Environment Research Council (NERC) organisations. MAREMAP is led by the BGS, the NOC and SAMS. Associate partner organisations include the University of Southampton, CCO, the University of Plymouth, the MCA, Cefas and Marine Scotland.<sup>39</sup> MAREMAP was formed to foster stronger connections between these organisations which have common interests, in order to pool resources and expertise. Seabed mapping activities within the MAREMAP project are predominantly focused on environmental and geological mapping, however, in some instances hydrographic data collection may also be required.

The BGS undertakes seabed mapping primarily to maintain and improve geological maps. MAREMAP projects represent a significant portion of BGS seabed mapping work undertaken. Applications of the geological mapping work include:

- de-risking investment for maritime industries;
- conflict resolution between marine user groups; and
- improving the understanding of bedrock geology or overlying sediments in areas determined to be of particular interest.

The NOC is a publically-funded research centre wholly owned by the NERC, which is primarily involved in seabed mapping for exploring anthropogenic impacts on marine habitats and ecosystems. NOC also have a strong interest in developing utilisations for novel seabed mapping survey technologies, such as Autonomous Underwater Vehicles (AUVs), including submarine gliders which are used to map the distribution of deep sea corals,<sup>40</sup> and LIDAR.

The SAMS is Scotland's largest provider of independent marine science data and works on projects in a range of fields including marine renewables, aquaculture, marine biotechnology, marine policy, deep-sea systems, climate change and polar science.

By coordinating the research undertaken by the lead organisations under the MAREMAP project – BGS, NOC and SAMS - there is a reduction in the degree of overlap between projects based on common scientific interests and geographic regions, as well as the sharing of expenses for survey work. Funding is underpinned by BGS, SAMS and the NOC who combined contribute around £1 million per annum from the NERC national capability funds.<sup>41</sup>

## **Programme Inputs and Processes**

---

<sup>39</sup> <http://www.maremap.ac.uk/view/information/about.html>

<sup>40</sup> MAREMAP, 2012. Investigating the feasibility of utilising AUV and Glider technology for mapping and monitoring of the UK MPA/MCZ network – MB0118. Available [Online] <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=18219&FromSearch=Y&Publisher=1&SearchText=mcz&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description> Accessed 16/12/2015

<sup>41</sup> <http://www.maremap.ac.uk/view/information/projectCost.html>

Within the MAREMAP partners there is a high capability to perform a range of survey types. Each partner organisation maintains their own fleet of vessels capable of deploying a range of equipment for seabed mapping.

While the majority of current BGS seabed mapping makes use of historical data or data produced and shared by other organisations, new data are also collected under MAREMAP. The Research Vessel (RV) *White Ribbon* operated by BGS undertakes IHO Order 1a hydrographic surveys, as well as ground truthing surveys using drop cameras and sediment grab samplers, MBES surveys and shallow seismic surveys. In addition to new surveys, BGS maintain a wealth of publically available data for bedrock geology and sediment types for waters within the UK.

SAMS through SRSL operates two research vessels, RV *Calanus* and RV *Seòl Mara*. These vessels carry a range of equipment for seabed mapping, including: MBES, side-scan sonar, sediment coring and grab sampling for biological and chemical data.<sup>42</sup>

The NOC manage the RRW *Discovery* and RRS *James Cook*, capable of performing offshore and deep water surveys within UK maritime boundaries, as well as worldwide. These vessels routinely collect seabed mapping data such as single-beam echo sounder and MBES data and seismic surveys, drop camera and remote operated vehicle camera surveys, as well as a range of sediment and bedrock sampling techniques and continuous water column data logging. These vessels are predominantly involved in complex surveys such as mapping deep sea corals and understanding human impacts on the seafloor.

### **Programme Outputs**

As the work undertaken by BGS, NOC and SAMS are predominantly scientific research programmes; the priority is on gathering data for scientific innovation and improving existing knowledge for the wider public good. For example, there is a high publication rate of peer-reviewed scientific literature stemming from the work these organisations undertake under MAREMAP. In addition, projects undertaken within MAREMAP support a diverse range of other projects, as well as planning and management decision-making.

All data collected as part of MAREMAP are made publically available via the MAREMAP website and portal.<sup>43</sup> Data sharing includes the raw data, metadata and reports, with all data sent to the relevant DACs for storage.

### **Planned Activities**

The future of MAREMAP projects are uncertain due to financial constraints, whereby the funding contributions that are brought together to underpin the programme's budget will be subject to re-bidding from NERC within the next two years. It should be noted however that the project outputs have been well regarded within the scientific

---

<sup>42</sup> <http://www.srsl.com/renewables/vessel-and-equipment-hire>

<sup>43</sup> <http://www.maremap.ac.uk/view/search/searchMaps.html>

community and an increasing number of organisations have become involved in the programme in recent years.

### 3.1.1.4 Marine Protected Areas (MPA) Evidence Programme

#### Programme Overview

The Marine Protected Areas (MPA) Evidence Programme captures a range of activities undertaken on behalf of the Department for Environment, Food and Rural Affairs (Defra), the Joint Natural Conservation Committee (JNCC) and Natural England (NE). All the work is undertaken to support the designation of a network of marine protected areas in UK waters. The programme has been running since 2012, replacing occasional one-off surveys that were previously undertaken separately. The main driver for the work is the national legislation introduced by the Marine and Coastal Access Act (2009), setting out the principles for developing an ecologically coherent network of marine protected areas in UK waters. Some of the work is also driven by the EU Habitats Directive.

The main programme is coordinated by Cefas on behalf of Defra and the work is overseen by the MPA Survey Co-ordination and Evidence Delivery Group (MPAG), which includes representatives from NE, JNCC, EA, Inshore Fisheries and Conservation Authorities (IFCA) and the MMO. MPAG prioritises the work to be undertaken based on currently available evidence and urgency within the designation process. The majority of the work involves the characterisation of seabed habitats to inform the designation process.

The survey work has been delivered in the past by government organisations including Cefas, the EA and the Agri-Food and Biosciences Institute (AFBI) in Northern Ireland, as well as commercial organisations following open tender competition. In the first year the programme budget amounted to about £5 million, whereas in recent years the baseline budget is around £2 million and occasionally topped up during the year.

#### Programme Inputs and Processes

Survey work for the MPA Evidence Programme focuses on environmental data to obtain detailed habitat information. Survey work utilises MBES to generate a detailed understanding of the seabed morphology and associated backscatter data for seabed characterisation. In line with the Pan-government Multi-beam Data Sharing Agreement all MBES data are collected to meet the IHO S44 Order 1a standard. The specification for the work builds on the CHP specification, but with some modifications and a higher priority on collecting high quality backscatter data, essential to inform the seabed characterisation as part of the habitat mapping process. For some sites, side-scan sonar data is also collected to help identify small seabed features. The acoustic data are supplemented with sampling and video observations.

The survey work is delivered by a range of organisations. A large part of the work is delivered by Cefas using the Defra owned RV *Cefas Endeavour*, and involving other government vessel operating organisations, such as the EA and the AFBI. During the first

three years of the programme, a significant element of the MBES survey work was undertaken by third party survey companies commissioned to undertake the work. Most of the companies awarded the work<sup>44</sup> were also awarded contracts under the MCA's CHP. In fact it is often the case that different government organisations contract the same third party contractors to undertake slightly different surveys, so there is definitely scope for more communication and coordination across contracts.

Whereas the majority of the sampling and video characterisation work has been undertaken by government organisations, the analysis is primarily undertaken by private sector organisations. The final reporting of all data has been led by Cefas, with some input from the BGS, CCO, NOC and University of Newcastle.

Regular coordination between Cefas, MCA and CCO takes place to ensure survey plans are shared and duplication of effort is avoided. Where sites of joint interest are identified, jointly funded surveys are commissioned to meet the requirements of all parties.

### **Programme Outputs**

The Secretary of State for Environment, Food and Rural Affairs has committed to release all of Defra's datasets, including data collected under the MPA programme. All data collected during surveys therefore are made publically accessible via the relevant DACs: UKHO for bathymetric data, BGS for backscatter data and the Marine Biological Association Data Archive for Marine Species and Habitat Data (MBA-DASSH). Any other data collected during the surveys are freely available upon request from Cefas. Data are only made available following extensive quality checks and site reports are fully approved by MPAG.

For the primary purpose of the programme, all data collected are analysed and developed into marine habitat maps using the European Nature Information System (EUNIS) classification system. The approach utilises the MBES bathymetry and backscatter data and combines it with sampling and video observations. The resulting habitat maps primarily describe the physical characteristics of the seabed, similar to geological seabed maps.<sup>45</sup>

As the programme has adopted a modified CHP survey specification which ensures all MBES data meet the IHO S44 Order 1a standard, the data is also provided to the UKHO for updating navigational charts.

---

<sup>44</sup> These are: Gardline, MMT, EGS, Titan Environmental Surveys, EMU and Osiris Projects. All these companies aside from Osiris Projects have all worked on the CHP.

<sup>45</sup>

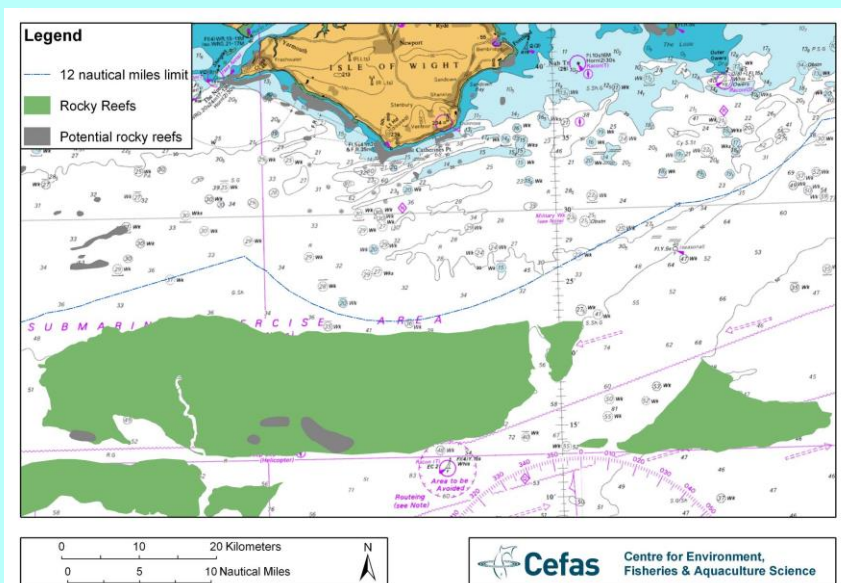
<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=18983&FromSearch=Y&Publisher=1&SearchText=mcz&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>



## Case Study: Seabed Mapping and Geological Discoveries

Seabed mapping data from the English Channel has resulted in a number of high profile geological discoveries. In the Eastern English Channel, researchers from Imperial College London collated all available bathymetric seabed mapping data to study a network of large ancient valleys. Investigations of the high resolution data provided for the first time evidence that these features were created by a megaflood event, as a result of the breach of a rock dam in the Dover Strait.

Further to the West, in the Central English Channel, a combination of historic and modern seabed mapping data revealed an extensive rock platform. The JNCC had identified potential rocky reef habitats from protection under the EU Habitats Directive. Based on the best available data from the British Geological Survey, a number of small rocky reef areas had been identified. A review of the historic and new data revealed a rock platform four times the size of the Isle of Wight, significantly larger than previous knowledge. In 2013 the site was confirmed as a Site of Community Interest (SCI).



Potential (grey) and actual rocky reef (green) coverage in the Central English Channel.

Source: Coggan, R, Diesing, M and Vanstaen K., 2009. Mapping Annex I Reefs in the central English Channel: evidence to support the selection of candidate SACs. Scientific Series Technical Report, Cefas Lowestoft, 145: 116pp.

### Planned Activities

The programme has been running as a rolling one-year programme, reviewed and extended on an annual basis. It is likely that work will continue in the near future, especially in relation to the monitoring of sites. There is, however, a desire to employ more autonomous and remote monitoring systems, which can be used to target more than limited vessel based seabed surveys.

## 3.1.2 Noteworthy Seabed Mapping Programmes

### 3.1.2.1 Welsh Government

#### Programme Overview

The Welsh Government has in the past tendered for a number of small seabed mapping projects. These are typically related to marine planning, stock assessments and meeting environmental directives (such as the Marine Strategy Framework Directive (MSFD)). In the past, seabed mapping activities have gathered baseline data for purposes such as assessing development projects, assessing fisheries and contributing to surveys for tourism.

#### Programme Inputs and Processes

Surveys performed for the Welsh Government have often been performed by academic institutions, such as Bangor University. These have used fishing vessels capable of performing some types of marine surveys. Surveys may involve the collection of side-scan sonar, underwater video, and grab sampling. Few surveys have been undertaken using MBES, which today is the most widely used type of seabed mapping tool. Design and operation of surveys are generally undertaken by third party organisations, commissioned to undertake the mapping and generate reports based on the collected data. Typically these projects do not make use of secondary data collected by other programmes, due to having limited knowledge of what has previously been collected.

#### Programme Outputs

These types of survey project generally produce reports as the main output, which in turn informs decision making. The reports are made public and shared with other organisations such as Natural Resources Wales. The raw data, however, is typically not made publically available.

#### Planned Activities

It is not known what marine surveys may be required in the future by the Welsh Government, as these are typically commissioned to meet a specific need identified at that time. However they are likely to continue to take place.

### 3.1.2.2 Department of Energy and Climate Change

#### Programme Overview

The Department of Energy & Climate Change (DECC) is responsible for policy and licencing for a number of marine industries, including offshore wind and oil & gas. A small amount of survey work (commonly around one survey per year) is conducted on behalf of DECC, typically motivated by monitoring programmes or exploration work. DECC has also commissioned occasional surveys to provide data for Strategic Environmental Assessments and to facilitate the development of projects in new areas. These surveys are often coordinated with other departments such as Defra, due to shared interest and to reduce costs.

## **Programme Inputs and Processes**

The responsibility for surveys undertaken on behalf of DECC is currently devolved to the environmental consultancy Hartley Anderson Ltd, which commissions third parties (either public or private) to undertake the work. Due to the diverse set of objectives of a single survey, a variety of equipment may be used. These include MBES and side-scan sonar surveys for exploration work and video and grab and core samples for chemical and biological analysis during monitoring surveys. DECC also uses data that is already available to inform projects and survey work.

## **Programme Outputs**

The survey work informs a range of reports and policies produced by DECC, traditionally for the oil & gas industry, as well as other organisations in recent years. In the past, surveys commissioned by DECC have also supported the identification and designation of Special Areas of Conservation (SAC) under the EU Habitats Directive and contributed to the UK meeting its obligations under the Convention for the Protection of the Marine Environment and of the North-East Atlantic (OSPAR Convention).

As a UK government department, DECC is committed to making all data collected freely available under an OGL. All data collected during DECC commissioned surveys are provided to the relevant MEDIN DACs.

## **Planned Activities**

As the DECC survey mapping programme is not a rolling programme, it is not known what marine surveys may be required in the future, as these are typically commissioned to meet a specific need identified at that time.

### **3.1.2.3 Northern Ireland Department of the Environment**

#### **Programme Overview**

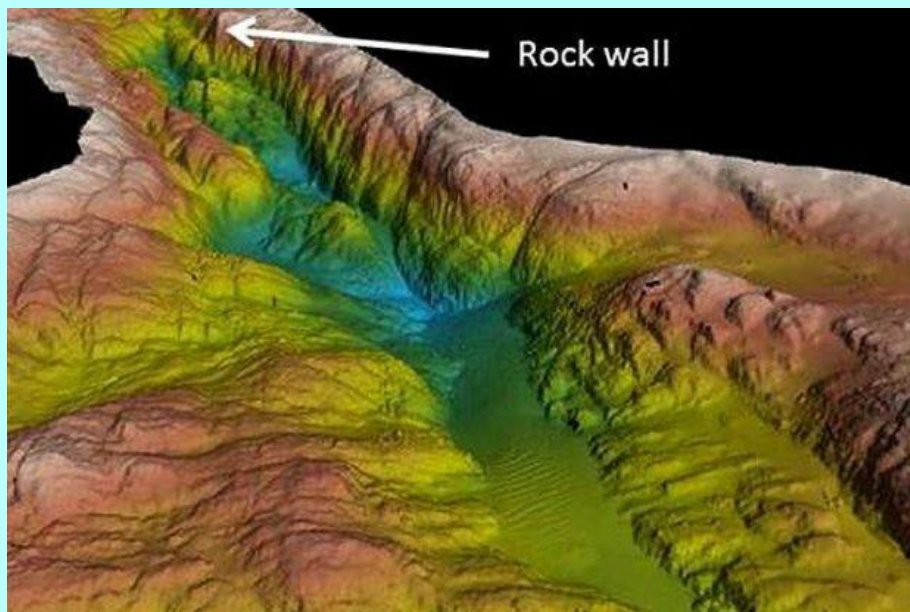
The Northern Ireland Department of the Environment (DOE) is responsible for protecting Northern Ireland's coastal and marine environment through implementing legislation, issuing licences and permits and through conservation activities. The majority of seabed mapping work has been conducted to assist Northern Ireland in developing a network of MPAs within Northern Irish waters. The main driver for the work is the Marine Act (Northern Ireland) (2013) and national legislation introduced by the Marine and Coastal Access Act (2009), setting out the principles for developing an ecologically coherent network of MPAs in UK waters. Some of the work is also driven by the EU Habitats Directive and other European Directives. The DOE regularly contracts the services of the AFBI to provide surveys and evidence to support DOE projects.

Surveys to support Northern Ireland's DOE objectives have regularly been conducted in coordination with other government departments. For example, in conjunction with the MCA, NERC and the Northern Lighthouse Board, the DOE provided match funding for the INIS Hydro project in the region of £3.9million, which was completed in 2014.

## Case Study: Seabed Mapping and Scientific Discoveries

As part of the INIS Hydro project, the Scottish Association for Marine Science (SAMS) led a survey of the entire Firth of Lorne. The survey area included the Sound of Corryvreckan, one of the world's most powerful natural whirlpools. It was believed that this phenomenon was caused by water thrust upwards by tidal movements against the sides of a steep pinnacle of rock projecting from the sea bed in the Sound.

The first ever high resolution seabed mapping survey of the area did however not reveal such steep rock pinnacle. Instead, the survey found that there is a steep-sided rock wall on the north shore of the sound. Scientific studies and hydrodynamic models developed for the area using the data revealed that it is this rock formation that is causing the upheavals in the sound when the tides are running.



Multibeam bathymetry data from the Corryvreckan Sound area. Credit: INISHydro

### Programme Inputs and Processes

The DOE maintains some survey capability, predominantly through the DARD RV *Banrion*. This vessel has predominantly been used for shallow survey work, and is capable of performing MBES surveys and deploying grab and video samplers. DOE also maintain a scientific dive team capable of performing seabed sampling.

Where necessary, the DOE has commissioned the services of the AFBI RV *Corystes* to perform surveys in deeper water. This vessel is capable of deploying a range of acoustic and ground truthing equipment, and has often been commissioned by the DOE to provide MBES and side-scan sonar surveys in areas of key interest. The DOE also uses pre-existing data, such as hydrographic and grab sample data held by the relevant DACs, where available, to support survey work and decision making.

## **Programme Outputs**

Surveys and seabed mapping data have predominantly been used to inform the designation and condition assessment of MPAs and SACs within Northern Irish waters. All data collected on behalf of the DOE is made freely available to any parties, on request, via the Geological Survey of Ireland. The DOE is currently in the process of setting up the Northern Ireland marine data hub, which will make data freely available publically.

## **Planned Activities**

Mapping activities conducted by the Northern Ireland's DOE are conducted on a need for basis and there is no ongoing programme. It is therefore not known what marine surveys may be required in the future.

It currently remains unclear what resources will be available for seabed mapping activities within Northern Ireland in the near future. It is expected that a restructuring of Northern Ireland's government departments will be undertaken. The Department of the Environment and Department of Agriculture and Rural Development (DARD) will be merged to create the Department of Agriculture, Environment and Rural Affairs (DAERA). This restructure is scheduled to be in place following the May 2016 Assembly elections. Furthermore in recent years the DOE has seen a 25% cut in its budget and staff, as well as 5% year on year cuts.

### **3.1.2.4 Marine Scotland**

#### **Programme Overview**

Marine Scotland is a directorate of the Scottish Government and is responsible for the integrated management of Scotland's seas, overseeing environmental sustainability. Marine Scotland funds and undertakes seabed mapping for four main sectors; marine spatial planning, marine renewable energy, the offshore hydrocarbon industry and marine biodiversity and fishing. Most of the seabed mapping work undertaken is in order to comply with national and EU legislation, including the Habitats Directive. Marine Scotland undertakes surveying activities all year round. Approximately 40% of those activities are commissioned work undertaken by contractors.

#### **Programme Inputs and Processes**

Marine Scotland owns two research vessels, RV Scotia and RV Alba na Mara, and uses these to conduct the majority of its seabed mapping activities. The vessels collect MBES, side scan sonar, ground truthing and asymmetry data covering deep and shallow waters. The data collected across the various activities also vary from bathymetric to environmental and geological. The various seabed mapping activities undertaken by Marine Scotland are used for a number of purposes. Examples include:

- to identify and clarify marine features in order to determine whether to designate nature MPAs;

- to identify areas where it would be possible to develop offshore installations for wind energy generation, to determine the impacts of potential developments by the hydrocarbon industry to the seabed;
- to assess the effects of trawling around pipelines;
- to review seabed habitats in lieu of decommissioning; and
- to determine the seabed positioning in lieu of mining activities.

Marine Scotland works closely with a number of organisations including Scottish Natural Heritage, the Scottish Geological Society, the Scottish Government Hydrographic Office and the Scottish Environmental Protection Agency (SEPA). Furthermore, they work closely with JNCC to prioritise areas to map and to ensure they are complying with all relevant legislation. These areas are re-evaluated on an annual basis. In order to better understand the mapping efforts and activities of other government organisations, improve coordination and ensure duplication of mapping, Marine Scotland also meets with Cefas and the Environment Agency regularly (once every six months) to share information.

On occasion Marine Scotland also utilises data from other sources to carry out its activities, for example when applicants have undertaken Environmental Impact Assessments (EIAs). Such data is usually made available free of charge to Marine Scotland as part of licensing procedures, as they are statutory consultees in relation to marine activities.

The costs of seabed surveys can range from £5,000 per day when conducting surveys using the smaller vessel, up to £12,500 per day when using the larger vessel. To design, procure, undertake, coordinate and review the surveys and the resulting data, as well as to actively seek funding, around 20 full time equivalent staff are required. Most of the funding for seabed mapping surveys comes from the Scottish Government (around 80%), with the remainder being sourced from other sources such as European programmes (examples include Horizon2020, INTERREG and the European Maritime Fisheries Fund), as well as other government bodies such as DECC.

### **Programme Outputs**

Marine Scotland make all of their raw data and value added materials (such as high resolution maps) publically available and free of charge through the Scottish Government website. Although no separate budget exists for data management, Marine Scotland primarily publish their seabed mapping data via two web-based tools; Marine Scotland Interactive<sup>46</sup> and the National Marine Plan Interactive<sup>47</sup>. These tools are live databases and there are now plans to merge them into one single database. Marine Scotland Interactive is designed to provide access to spatial data and covers renewable energy, monitoring, conservation and marine planning, with the aim being to add new

---

<sup>46</sup> <http://www.gov.scot/Topics/marine/science/MSInteractive>

<sup>47</sup> <http://www.gov.scot/Topics/marine/seamanagement/nmpihome>



environmental themes in time. It also works with Google Maps. Many efforts have been made to make the data easily accessible and online instructions on how to use the tool are widely available. As a result it has been nominated for awards by the offshore renewables sector, which often report back to Marine Scotland on how useful the tool and its data is. The National Marine Plan Interactive provides a number of different layer files covering topics such as pipeline locations and fishing activities. Registered users can also add their own data to the National Marine Plan, as long as it satisfies certain criteria. The tools are not officially part of MEDIN but seek to follow MEDIN principles in regards to data acquisition and storage.

### **Planned Activities**

The majority of seabed mapping work undertaken by Marine Scotland can be considered to be long-term (i.e. continuing on for the next five to 10 years) and includes activities to develop Scotland's national marine plan and to collect information on the appropriateness of human activities on the seabed and their cumulative impact.

One of the priorities of Marine Scotland over the next five years is improving management of and access to the seabed mapping data it collects, and as such, a 5-year programme has been developed to ensure statutory compliance and to make data widely accessible. Staff time (e.g. the Data Manager, IT Manager and Quality Manager, as minimum) and money (over half a million has been spent on two new back-up facilities for data storage) have already been committed to improve current practices. Furthermore, Marine Scotland is undertaking some work to assess the value of the seabed mapping data it is making widely available, both in terms of its economic value, but also in terms of how useful this data can be for different industries, for research and development and innovation, for de-risking investment and other uses.

### **3.1.3 Other Programmes / Data Users**

In addition to the main and noteworthy public sector seabed mapping projects discussed above, there are also a number of other organisations which may not undertake or commission seabed mapping surveys directly, but do make extensive use of marine and seabed mapping data. The four prominent users of seabed mapping data discussed in this section are The Crown Estate, the MMO, the UKHO and Historic England.

#### **3.1.3.1 The Crown Estate**

The Crown Estate issues licences or leases for offshore developments, often requiring licence or lease holders to collect extensive seabed mapping data (whether it's bathymetric, geological, environmental or a combination of these), to inform the development or to comply with regulatory requirements. The Crown Estate then collates data from its licensees and has developed the Marine Data Exchange (MDE) database to facilitate the exchange of all survey data (including seabed mapping) collected as part of offshore renewable developments, free of charge.

### **3.1.3.2 The Marine Management Organisation (MMO)**

The MMO is the body responsible for licensing, regulating and planning marine activities in the seas around England and Wales. While not directly involved in undertaking seabed mapping work, the MMO is a regular user of seabed mapping data to underpin the licence and regulatory process it administers. The availability of quality seabed data is therefore critical to the MMO as it influences the validity of management and regulatory decisions made for the industries it regulates.

### **3.1.3.3 The UKHO**

The UKHO is the body responsible for producing and update nautical charts and other publications and for providing relevant services to the Royal Navy and merchant shipping to protect lives at sea. Although not directly involved in seabed mapping work, like the MMO they are regular users of such data provided by other organisations which undertake the surveys such as the CHP. The UKHO is also responsible for the hydrographic DAC on MEDIN where all hydrographic data is stored.

### **3.1.3.4 Historic England**

Historic England is the government's independent expert advisory service for England's historic environment. As part of its remit, Historic England is the Government's lead advisor on heritage matters in England, which includes the limit of the UK marine area adjacent to England. Specifically it provides advice regarding the designation and management of the historic marine environment within the English inshore marine plan areas (i.e. up to the 12 nautical mile limit). It also provides advice relevant to inform the planning and licensing functions of competent authorities such as the MMO for the English offshore marine plan areas (i.e. up to the 200 nautical mile limit or the median line with an adjacent State).

To carry out these duties Historic England relies on the use of marine mapping data, particularly bathymetric and geological data on the seabed and data pertaining to the seabed infrastructure (e.g. cables, pipelines, oil and gas rigs, wind farms, etc.), as well as any seabed obstructions and wrecks. Like the MMO, they are regular users of seabed mapping data provided by other organisations that undertake the surveys and in some instances, Historic England may also derive new seabed mapping data in conjunction with other data sets it licences.

## **3.2 Private Sector Programmes and Activities**

This section describes the largest private sector programmes and activities currently being undertaken, which have been made publically available. Like the public sector, the private sector is also actively engaged in commissioning and utilising seabed mapping data to support their activities.

Almost all activities in the marine environment require the use of seabed mapping data. The shipping, fisheries and marine recreation industries are three prominent sectors that use seabed mapping data, but rarely commission it.



The shipping sector makes use of hydrographic data in the form of navigational charts and other publications produced by the UKHO (using survey work undertaken by the CHP) that inform shipping routes and protect lives at sea. Similarly, the marine recreation sector requires the use of UKHO admiralty charts and other products for navigation and use on navigational aids such as GPS. The fisheries sector is a third sector that also requires navigational aids, but in addition also utilises data to inform the assessment and management of fishery stocks.

In some instances the need for marine data is so great, that private sector organisations commission the collection of bespoke and specialist mapping activities. This is especially relevant for the marine aggregates, offshore renewables, ports, oil & gas and telecommunication sectors.

In the following sub-sections some of the most prominent programmes and activities of the private sector are summarised. Like the summaries provided for the public sector programmes, the following information is summarised:

- Programme/Activities Overview;
- Programme/Activity Inputs and Processes;
- Programme/Activity Outputs; and
- Planned Programmes/Activities.

### 3.2.1 Marine Aggregates Regional Seabed Monitoring Plans

#### Programme/Activities Overview

In 2014, a series of Regional Seabed Monitoring Plans (RSMP) were commissioned by the aggregates industry to establish the baseline environmental conditions across five regions in the UK: the Humber, the Anglian, the Outer Thames, the Eastern English Channel and the South coast. Overall, the RSMP programme applies to over 60 marine aggregate production licence and application areas in the UK.<sup>48</sup>

Funded entirely by the aggregates industry, the surveys were coordinated by the British Marine Aggregate Producers Association (BMAPA), the trade body for the marine aggregates industry in the UK. They were undertaken to fulfil the compliance requirements associated with the seabed sampling conditions attached to marine licences for marine aggregate extraction from 2013 onwards.

Under these conditions, operators are required to provide data to the regulator to monitor seabed benthos and sediments. It is understood that in the past surveys were typically commissioned by operators at an individual licence area. The proximity of many licence areas to one another meant that there has been significant duplication of time and effort in collecting this information. The objective of the programme was therefore

---

<sup>48</sup> British Marine Aggregate Producers Association, 'Marine Aggregate Regional Seabed Monitoring Plans (RSMP): Cost/Benefit Statement on Behalf of the Marine Aggregate Sector', 2014.

to reduce the effort spent through the introduction of regional surveys that could deliver the requirements of every operator.

For each region, Cefas (on behalf of Defra) fed into the specification of the survey to ensure that it was fit for purpose. This was done as part of a project co-funded by the aggregates industry, The Crown Estate, Defra and the MMO.

In addition to the RSMPs, new aggregate extraction sites require survey work to be undertaken in order to perform detailed resource assessments. These assessments identify the distribution and abundance of marine aggregate resources and allow them to be considered in the marine spatial planning process. These surveys are carried out at both a regional and project level and tend to focus on physical parameters, assessing the sediment type (the resource), bathymetry and sub-bottom profile of the seabed. Additionally, a lease from The Crown Estate and permission from the regulator (MMO or Marine Scotland) must be obtained before commercial extraction can begin. This process requires a project specific EIA, which in itself requires a number of surveys that are more focused on biological receptors such as the benthic habitats and fish resource, but also assesses potential archaeological features of the area.

### **Programme/Activity Inputs and Processes**

Third party contractors are commissioned to undertake the surveys that primarily collect grab samples of the seabed, preserved for analysing in a benthic laboratory.<sup>4950</sup> Survey work may be carried out for various purposes, such as to support project design, inform operational management and to fulfil regulatory obligations for a project. On a regional scale, large amounts of information on bathymetry, seabed surface features (via side-scan sonar), sub-bottom profiles, sediment type, benthic habitats and maritime archaeology are collected by the aggregates industry for key marine aggregate regions.<sup>51</sup>

Although it was not possible to establish the exact number of staff involved in the design of the surveys, given the scale of the programme it seems likely that a number of individuals (across BMAPA, Cefas and other organisations that might have fed into the design) will have been involved. The same applies to the number of staff involved in undertaking the surveys.

### **Programme/Activity Outputs**

The main output from the programme is the delivery of benthic samples for the purpose of achieving compliance with marine licences for aggregates extraction. Although data has not been made publically available, it can be accessed through a Freedom of

---

<sup>49</sup> <http://www.apemltd.co.uk/news/marine-aggregates-industry-chooses-apem>

<sup>50</sup> <http://www.dredgingtoday.com/2014/08/22/mesl-selected-for-regional-seabed-monitoring/>

<sup>51</sup> ABPmer, (2015). A Review of Access to Industry Environmental Data. A report produced by ABP Marine Environmental Research Ltd for Productive Seas Evidence Group, November 2015. Available [Online] <http://www.gov.scot/Resource/0049/00490558.pdf> Accessed 11/12/2015.

Information Request, under the premise that data submitted by a licensee to comply with the conditions of a Marine Licence becomes a matter of public record.

The third party survey contractors undertaking the mapping do not own the data but typically store it on behalf of the client. Under this programme there has been no separate budget for data management, with the amount set aside for such a cost being nominal at this stage.

BMAPA has done some work to quantify the expected savings from the RSMP programme. Over the 15-year licence term, savings are expected to be in the region of £5.8 million.<sup>52</sup> This reflects a 50% saving in comparison to the costs required to deliver benthic monitoring under the traditional compliance methodology, achieved by reducing the duplication of sampling effort.

### **Planned Programmes/Activities**

The RSMP programme intends to collect data for the full period of the marine aggregates production licences, which is typically around 15 years. This is to ensure that conditions associated with the licences are being fulfilled. Follow-up surveys also need to be undertaken every five years up to 2028, to feed into the reviews for marine licences undertaken by the MMO.

Given the apparent success of the RSMP programme, BMAPA has been involved in discussions with the MMO to align the timing of all standard monitoring requirements (including acoustic surveys) in each region, so they can be delivered in a similarly coordinated way.

It should be noted that the MCA has made repeated efforts to collaborate with the marine aggregates industry in undertaking survey work and the sharing of data. However, due to the sensitive nature of the data collected, no action has yet been taken to joint fund survey work. Such partnerships could be areas to explore further under the national programme.

## **3.2.2 Transatlantic Telecommunication Cable Survey**

### **Programme/Activities Overview**

Submarine telecommunication cables are vital to the transfer of information and communications across stretches of ocean. Discussions with a company specialising in telecommunications revealed that they had recently completed laying a cable underneath the Atlantic Ocean from Canada to Western-Super-Mare in the UK.

Before laying the cable, survey data was required to inform the design of its route. In shallow water (<1,500 m) MBES and side-scan sonar data was collected for bathymetric

---

<sup>52</sup> British Marine Aggregate Producers Association, 'Marine Aggregate Regional Seabed Monitoring Plans (RSMP): Cost/Benefit Statement on Behalf of the Marine Aggregate Sector'.

and geological uses. For certain areas of the seabed – where the cable needed to be buried – core and grab samples were also collected to analyse any changes in seabed topography picked up by the echo sounder and side-scan sonar data.

Wholly funded by the private sector, the design of the survey took one person six to eight weeks to complete. Survey contractors took approximately six months to collect the required data.

Although it was not considered easy to assign an economic value to the data, one way to reflect on its worth is through the avoided cost of maintenance work. For example, laying a transatlantic telecommunication cable can cost several million pounds. A cable that is well routed and securely installed as a result of accurate survey data is likely to have fewer faults. Given that submarine cable repair is expensive; the value of this data is potentially huge.

### 3.2.3 Offshore Renewables Industry

#### **Programme/Activity Overview**

The recent developments of offshore wind, tidal stream and wave energy projects in the UK make the UK one of the global leaders in marine energy.<sup>53</sup> Although a number of offshore wind projects have entered commercial operation around the UK, a number of tidal stream and wave energy projects are still yet to be commercially developed. During project development, marine surveys are typically carried out at both a regional and project level and tend to focus on determining the value of the resource and assessing suitable locations for infrastructure development. Additionally, a lease from The Crown Estate and permission from the regulator (MMO or Marine Scotland) must be obtained before infrastructure development can begin. This process requires a project specific EIA, which in itself requires a number of surveys that are more focused on biological receptors (such as the benthic habitats and fish resource), but which also assess potential archaeological features of the area. Where developments have entered the commercial operation stage, it is a requirement of the licence for continued monitoring to be undertaken.

#### **Programme/Activity Inputs and Processes**

A variety of data is required to be collected during major development projects for renewable energy. This include: MBES; side-scan sonar; seismic and shallow seismic work; a variety of water column data; sediment grabs and cores; and biological data using grab samples. Private companies which specialise in marine surveying are usually commissioned to undertake these surveys.

---

<sup>53</sup> RenewableUK. 2015. Renewable Energy. Available [Online] <http://www.renewableuk.com/en/renewable-energy/index.cfm>. Accessed 17/12/2015.

Each individual renewable energy developer tends to commission survey work specific to the need of their own project. However, some companies have begun to collaborate, where possible, in order to spread the costs of survey work more widely. Hydrographic data are commonly collected to the IHO S44 Order 1 standard, which is driven by the MCA insistence that all surveys abide by the Marine Guidance Note 371, which requires offshore developers to conform to this standard as part of the Navigation Risk Assessments.<sup>54</sup>

### **Programme/Activity Outputs**

Overall, the offshore renewables industries have been increasingly positive about providing data to organisations such as The Crown Estate for public access via the MDE database. Commercial sensitivity is the main reason why data collected by private sector seabed mapping programmes are not as widely available, particularly during the project development phase. However all Round 3 offshore wind farm developments need to collect data and provide it to The Crown Estate to be made available on the Marine Data Exchange.

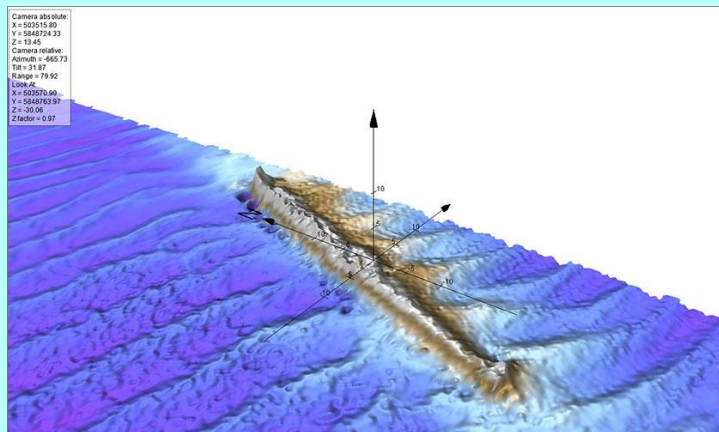
---

<sup>54</sup> ABPmer, (2015). A Review of Access to Industry Environmental Data. A report produced by ABP Marine Environmental Research Ltd for Productive Seas Evidence Group, November 2015. Available [Online] <http://www.gov.scot/Resource/0049/00490558.pdf> Accessed 11/12/2015.

## Case Study: Seabed Mapping and Archaeological Discoveries

### SEABED MAPPING AND ARCHAEOLOGICAL DISCOVERIES

Advances in high resolution seabed mapping has led to a significant number of archaeological discoveries in the last few decades. High resolution multibeam echosounder surveys regularly discover uncharted wrecks or seabed obstructions. One of the most recent archaeological discoveries was the German U-31 submarine off the Suffolk coast. The survey undertaken by Fugro on behalf of Scottish Power Renewables first discovered the uncharted wreckage in 2012. Diving and historical research revealed in 2015 that the wreckage was that of the missing German U-31 submarine, who was last spotted in January 1915.



German U-31 submarine discovered off Suffolk. Credit: Fugro/Scottish Power Renewables

Other archaeological applications include monitoring of the wreck of the SS Richard Montgomery, an Allied World War 2 Liberty Ship, which sank in 1944 with 7,000 tonnes of munitions on-board. The Civil Hydrography Programme undertakes regular high resolution multibeam echosounder surveys of the wreck to monitor its condition.

### Planned Programmes/Activities

The tidal stream and wave energy sectors are still in their infancy. However, it appears likely that significant projects are likely to be developed in the future, with a number of wave and tidal lease sites currently in development and planning stages.

Similarly, industry projections indicate the expansion of offshore wind energy generation by 2020 (Renewable UK, 2015).<sup>55</sup> While the nature, timing and locations of future development projects are unclear, there will definitely be a demand for additional seabed survey work to inform these operations.

### 3.2.4 Oil & Gas Industry

#### Programme/Activities Overview

<sup>55</sup> Ibid.

The offshore oil and gas industry has grown significantly since the 1960s and is particularly active in the North Sea. However, the sector has no large scale or overarching seabed mapping programme within UK waters. Instead the industry has historically undertaken a large number of seabed surveys in support of site developments and licence requirements.

### **Programme/Activity Inputs and Processes**

Individual oil & gas operators undertake surveys of sites where offshore developments are planned. Besides seismic and geotechnical surveys, the surveys often include an element of seabed mapping (i.e. hydrographic, geological and environmental). Where existing infrastructure exists, pipeline inspections are also routinely undertaken and comprise a significant percentage of the industry's total expenditure on mapping surveys. In addition, the industry commissions exploratory survey work to assess suitable areas for development (such as for the discovery of new resources). However it has been estimated that this comprises less than 5% of the sector's total expenditure on mapping surveys.

The surveys are undertaken on a site by site basis, and it is understood that there is little coordination between the industries in terms of undertaking seabed mapping surveys. There are also no industry-wide standards for these seabed mapping surveys. In response to this, in 2015, Oil & Gas UK initiated a project to develop industry seabed survey standards.

The surveys for the oil & gas industry are typically undertaken by third party contractors, which are commissioned to deliver the work. The seabed mapping work often involves the collection of seismic, MBES, side-scan sonar, grab samples and video/ROV observations. Analysis of the data often includes full community analysis of biological data and the production of seabed geology and habitat maps.

The industry has been exploring the use of marine robotics such as AUVs to undertake survey work, in response to a drop in oil prices and diminishing budgets. Whilst some of this technology is still under development, it is expected that it will become a very effective way to increase efficiencies and reduce costs of survey work in the near future. The oil and gas industry has invested heavily in this field in recent years due to the marketable and exportable nature of such technologies and the sheer amount of data they can collect with minimal risks. It expects to continue to do so in the future. This technology is discussed further in the case study on AUVs in Section 4.2, as well as in Section 6.2.6.

### **Programme/Activity Outputs**

The seabed mapping data collected by the oil & gas industry has traditionally not been made publically available due to its commercial nature. The data sharing initiatives that have taken place are limited thus far. Bathymetry data are shared with the UKHO to

update navigational charts. Furthermore, the UK Benthos database<sup>56</sup> has been set up by Oil & Gas UK to collate all offshore environmental benthic survey data in the UK sector of the North Sea by the oil and gas industry since 1975.

Such initiatives are seen as beneficial to the industry itself, allowing others to use the data to study large scale temporal changes. Metadata about site survey information from operators is also made available to MEDIN.

### **Planned Programmes/Activities**

No detailed information on planned seabed mapping activities of the oil & gas industry is available. However, it is expected that more seabed mapping data will need to be collected in the future as part of new developments and for the purposes of monitoring existing infrastructure and resources of the sector. Clearly the price of hydrocarbon is likely to be a key factor that will determine investment in mapping activities.

## **3.3 Common Themes Across all Seabed Mapping Programmes**

### **3.3.1 Overlap in Survey Areas**

Through the research conducted as part of this scoping study, it was determined that there can be duplication of effort with the same areas being mapped several times over, which can result in the inefficient use of resources. Examples include the CCO survey along the northern shores of the Isle of Wight, which only collected bathymetry data, and was then re-surveyed as part of the MPA Evidence Programme to obtain backscatter data. Similarly, an area surveyed south of Start Point by Cefas on behalf of Natural England for habitat mapping purposes, did not have sufficient sounding density to meet the CHP specification and as a result was re-surveyed by CHP contractors.

Within the public sector, the need for coordination between marine mapping programmes has been acknowledged and efforts have been made over the last decade to improve coordination and communication between the various interested parties, predominantly driven by the desire to maximise the value for money for the limited funding available. Consequently, there is frequent collaboration between organisations within the public sector to share resources and prevent overlap between surveys. This is clearly demonstrated by programmes such as MAREMAP, which share resources in order to provide the most cost-efficient surveys and the Memorandum of Understanding for sharing hydrographic data with the MCA signed by thirteen government organisations. However, it was remarked how beneficial it would be if there was greater communication between the public *and* private sectors.

---

<sup>56</sup> [http://oilandgasuk.co.uk/knowledgecentre/uk\\_benthos\\_database.cfm](http://oilandgasuk.co.uk/knowledgecentre/uk_benthos_database.cfm)



This duplication of effort also appears to take place in the private sector. In some cases this may simply be the result of two survey boundaries overlapping or it is often driven by insurance requirements for site surveys prior to construction. In other instances however, depending on the data requirements of a project, there may be the need for an entire area to be re-surveyed to collect data of higher resolution or to fulfil different needs (i.e. environmental, bathymetric, geological, etc.).

Some practical examples of this duplication of effort are:

- (i) in the oil & gas industry –the drilling of a second exploratory hole in a previously surveyed area - strictly for insurance purposes; or
- (ii) in the cables industry, when a pipeline is being installed in the same area as an existing one. In these instances the reason for re-surveying relates to the need for up-to-date information, and it is expected that these kinds of activities will continue regardless of the existence of a national programme.

In the case of the aggregates industry, operators often find that the data currently available (whether from public or private sources), is not of the requisite resolution required for either regulatory or operational purposes. This may be true of other industries operating in the marine environment, each of which will have very specific data requirements. In this instance, a national programme which prescribes that all data must be collected in accordance with a national or international standard and/or using prescribed equipment and technologies, could remove the need for the same area to be surveyed multiple times. Furthermore under a national programme improved coordination and communication between the private and public sector will increase the potential for partnerships, which could reduce costs and make data more widely accessible. It is, however, acknowledged that even under a national programme, individual surveys will continue to take place and some degree of overlap will continue to exist, particularly in the instance of private sector surveying to support construction and insurance and risk concerns. More information on the potential benefits of a national programme is outlined in Section 5.0.

### 3.3.2 Data Management

Another key area explored during this scoping study was the extent to which existing seabed mapping data is being shared, managed, stored and made available for other organisations to use, and what implications this may have for a national programme.

For the public sector, there have been a number of initiatives to share data amongst organisations. One of the most important is the Memorandum of Understanding (MoU) created by the MCA and DEFRA, covering hydrographic survey data and data gathering, increasing offshore survey efficiency for government organisations. The MoU complements the Government's open license on public sector data and has been signed by a number of organisations including:

- MCA;
- Defra;
- UKHO;

- AFBI;
- BGS;
- CEFAS;
- JNCC;
- Marine Scotland;
- MoD;
- NE;
- Natural Resources Wales;
- Scottish Natural Heritage; and
- The Crown Estate.

The aims of the MoU are to facilitate the free exchange of data between organisations and set up methods to ensure future surveys (by participating organisations) are programmed in a way that avoids survey effort being duplicated.

Alongside the MoU, the Civil Hydrography Annual Seminar is another way through which survey co-ordination has been taking place, whereby industry and public sector organisations can come together and discuss upcoming activities and data needs. Through these efforts the MCA, Cefas and the CCO have been directly and routinely co-ordinating with regards to their seabed mapping activities. Moving forward, this coordination is likely to continue, although for Cefas this will be in a more limited capacity.

To share data, an open source platform for marine data is used through MEDIN. MEDIN shares data through a network of accredited DACs, which ensure the long term storage and access to marine data. Each DAC is maintained by the relevant government organisation. These are:

- BGS for seabed and sub-seabed geology and geophysics data including backscatter;
- the Archive for the Marine Species and Habitats Data (DASSH) for flora, fauna and habitat data;
- British Oceanographic Data Centre (BODC) that is part of the NOC for water column oceanographic data, as well as for other seabed mapping data including surveys undertaken by NERC ships in support of NERC science programmes;
- UKHO for hydrographic data; MET Office for marine meteorological data; Archaeology Data Service (ADS) for marine historic environment data; and
- Marine Scotland, Cefas and DASSSH for three DACs for marine fisheries data.

These DACs cover a wide range of data types, with the metadata accessible through a MEDIN portal to allow searches to be conducted for data held within them.

Signatory members of the MoU have typically made the vast majority, if not all data they collect, freely available under an OGL or similar arrangement. This is already benefiting numerous organisations; for example the UKHO uses hydrographic data from a range of sources to update its navigational charts.<sup>57</sup> Similarly, MBES data held by the UKHO and BGS DACs are used for a wide range of applications including:

- EIAs for marine development activities;
- marine conservation objectives; and
- marine monitoring decision making.

While there has been increased effort within many public sector organisations to share marine data, there is the potential to further develop this network. For example, despite being available on an OGL, data from the EA still needs to be requested, as it is not currently published on MEDIN DACs. Therefore, there may be limited knowledge of the extent of currently available data.

The MoU is generally accepted as being beneficial to a wide range of public as well as private sector groups. However, the sharing of data from the private sector is only made available on a voluntary basis. The MDE was launched by The Crown Estate in February 2013 to provide anyone with an interest in the marine environment access to survey data and reports collected during the planning, building and operating of offshore renewable energy projects and the aggregates industry. Offshore renewable energy developers provide data to The Crown Estate and this information is freely available via the MDE, dependent on the commercial sensitivity of the data. This data will eventually be housed within the relevant DACs. The cost of gathering the data currently contained within the MDE is estimated to be in the region of £150 million and it's expected to be around £500 million by the end of the existing programme of planned offshore wind farms (i.e. assuming they're all built and operating).<sup>58</sup> The datasets held within the MDE are a valuable resource to industry, as well as for functions performed by governmental departments and statutory nature conservation bodies.

For the private sector, for example, the cables industry suggests that the raw data they collect is sometimes shared for government and academic research. In these cases it will typically be provided in CD format, free of charge. However, this would only be undertaken once the data was no longer commercially sensitive. The cables sector is also understood to make use of data from the Irish National Seabed Survey (INSS), commenting that it can be as good a quality as some of the data they collect themselves. Some companies try and reduce the amount of surveying they do, especially in deeper waters. If good quality bathymetry data is available to access it means that companies

---

<sup>57</sup> <https://www.gov.uk/guidance/share-hydrographic-data-with-maritime-and-coastguard-agency-mca>

<sup>58</sup> ABPmer, (2015). A Review of Access to Industry Environmental Data. A report produced by ABP Marine Environmental Research Ltd for Productive Seas Evidence Group, November 2015. Available [Online] <http://www.gov.scot/Resource/0049/00490558.pdf> Accessed 11/12/2015.

can get by without doing a huge amount of deep water surveying themselves. An example of this was a study by Smith & Sandwell that explored global seabed topography.<sup>59</sup>

Similarly in the aggregates industry if data was requested by a regulatory body, this data would most likely be provided free of charge. If, however, the party requesting access to the data was another commercial enterprise, then there may be negotiation associated with a financial contribution for the data. Such instances were considered to be very rare.

Survey contractors who are commissioned to undertake seabed mapping activities on behalf of clients, collect large quantities of survey data that is owned by their clients and not themselves. Therefore they are not able to share it without the client's permission or capitalise on its existence. However, survey contractors might, during the early development phases of some projects, make use of existing secondary data for the purposes of the project. Depending on the project budget, this might include geophysical data from OceanWise (acquired at a cost) or WesternGeco (free of charge) datasets.

However, in most instances there is a preference for primary data as secondary data sources rarely contain data at an appropriate resolution required for the client specification. In some instances, clients may have also put forward their own data from previous surveys to assist with a project. This is particularly the case for comparative studies, where the same area of the seabed needs to be monitored for change over time.

With regards to data storage, the approach of third party survey contractors varies according to sector and client specifications. In some cases, the survey data might be provided to the client in hard copy format. In others, it might be stored on a central server on their behalf, if this forms part of the total cost of the project.

Data management will be a critical part of any national programme and it was clear during this study that there's a desire to improve the sharing of information across the public-private sectors, both for informing survey activities and avoiding duplication of effort and for informing end users, such as planning and development decisions, regulatory compliance and research. Currently there are many different methods for managing what are effectively the same datasets, which is an inefficient use of resources. This is expected to improve under a national seabed mapping programme.

### **3.4 Management of Other National Programmes**

As part of this scoping study other key national seabed mapping programmes have also been reviewed to establish their scope, as well as how they are being managed and

---

<sup>59</sup> Smith, W.H.F. and Sandwell, D.T., 'Global Seafloor Topography from Satellite Altimetry and Ship Depth Soundings', *Science* 277 (26 September 1997): 1957–62.

funded, in order to determine whether any of their characteristics would be transferable to a UK programme. The programmes which have been reviewed and are summarised in this section are the MAREANO project in Norway, the Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) programme in Ireland and the Land Information New Zealand (LINZ) coordination of the Pacific regional Hydrography Initiative. All these programmes are examples of nationally coordinated initiatives that have been international leaders in marine survey.

### 3.4.1 MAREANO (Norway)

MAREANO is a Norwegian cross-sector public initiative, which established a common mapping programme in 2006. MAREANO has been developed by the Institute of Marine Research (IMR) in collaboration with the Geological Survey of Norway (NGU) and the Norwegian Mapping Authority Hydrographic Service (NHS). These three organisations comprise the Executive Group that is responsible for carrying out MAREANO field sampling and scientific activities. The Programme Group, led by the Directorate of Fisheries, has the executive responsibility for MAREANO activities. The project aims to map and carry out baseline studies of the seabed's physical, biological and chemical environment. The information is needed for the sustainable management of Norway's marine territory.

The Programme is financed by the Ministry of Trade, Industry and Fisheries, and the Ministry of Climate and Environment. These Ministries, inclusive of the Ministries of Petroleum and Energy, Local Government and Modernisation and the Ministry of Transport and Communications, form the MAREANO Steering Board. The MAREANO budget has increased from Norwegian Kroner (NOK) 23.6 million in 2006 to over NOK 90 million in 2014.<sup>60</sup>

MAREANO originally prioritised data collection in the Barents Sea and areas off Lofoten, as these areas were thought to be particularly important for fisheries and future petroleum activities. Since entering the second phase of the programme, the target areas were expanded to include shelf areas of the Norwegian Sea.

A diverse range of marine survey and mapping techniques are utilised in the MAREANO programme. MBES are used to develop detailed maps of bathymetry and backscatter. Ground truth samples of sediment type, benthic fauna and environmental contaminants are collected through video and grab samples. Biological data are supplemented through the use of epibenthic sledges and beam trawls. From these products, an interpretation of the geology and seabed can be created to produce a classification map of the seabed.

The seabed mapping survey programme produces a range of deliverables including: sediment and geological information; biological information (benthic fauna, animal communities, biodiversity and biological production); chemical environmental status of

---

<sup>60</sup> [http://www.mareano.no/en/about\\_mareano](http://www.mareano.no/en/about_mareano)

sediments; and detailed bathymetry maps. Furthermore the programme has developed a database and map service, which is freely accessible online and contains all information within the Norwegian Sea and coastal areas. All results collected during surveys and post survey analysis are made available to all interested parties and updated continuously on the MAREANO website. MAREANO mapping results are also distributed through a collaboration called Norway Digital and the web portal 'geonorge.no'. Through Norway Digital, a variety of government and private sector organisations have also collaborated to provide access to data collected by other institutes for different purposes.

The MAREANO programme has been vital for the Norwegian Government in terms of informing the formation of management plans for the Norwegian Seas. Data gathered by MAREANO is the main source of knowledge for the management of marine resources in Norwegian territories, and provides valuable information regarding the effects of human activities on the seabed.<sup>61</sup> The high quality data products delivered by the programme have proven to be of high value for developing an ecosystem-based management approach and the development of marine protected areas within Norway, as well as influencing the management of fisheries and being used by the oil industry and by shipping traffic. Due to increased survey effort through the MAREANO programme, there have also been new discoveries, such as identifying new areas of cold coral reefs.<sup>62</sup>

### 3.4.2 INFOMAR (Ireland)

The Irish National Seabed Survey (INSS) officially started in 2009 with the intention of mapping the outer margins of Ireland's territorial seabed and eventually, its shore. It lasted for six years and data collection focussed on gathering full MBES coverage of the seafloor with limited seabed sampling to enable the generation of seabed classification maps. The collection of acoustic data and sediment samples were prioritised as it was felt that these datasets were of the highest priority for stakeholders within the area.

Following INSS, INFOMAR was created to map the remaining areas of Irish territory, including the most commercially valuable inshore areas. INFOMAR is a nationally funded programme that began in 2006 and is set to run for 20 years. Its objective is to unlock the potential of the marine environment within Ireland by developing a detailed map of the seafloor. It was thought that the additional data would facilitate development of industries such as aquaculture, aggregates, fisheries, cables/pipelines, port approaches and more recently, offshore renewables.<sup>63</sup>

---

<sup>61</sup> Buhl-Mortensen, L., Hodnesdal, H., Thorsnes, T., 2015. The Norwegian Sea Floor, MAREANO. Available [Online] <http://www.mareano.no/en/results/the-norwegian-sea-floor-published-2015> Accessed 11/12/2015.

<sup>62</sup> Ibid.

<sup>63</sup> INFOMAR, 2007. Proposal and Strategy. Available [Online] [http://www.infomar.ie/documents/INFOMAR\\_Proposal\\_Strategy.pdf](http://www.infomar.ie/documents/INFOMAR_Proposal_Strategy.pdf) Accessed 16/12/2015.

INFOMAR is jointly managed by the Marine Institute and the Geological Survey of Ireland, funded by a single revenue stream through the Department of Communications, Energy and Natural Resources. The seabed mapping programme was initially anticipated to cost approximately €80 million over the 20 years. The original annual budget of €4 million however was reduced to €3 million per annum, following major macro-economic changes in Ireland. Budgets and survey work are carried out on a yearly basis without the ability to spread budgets across multiple years.

At the onset of INFOMAR, a two-year consultation process was conducted to engage with stakeholders and prioritise mapping for the remaining areas of seafloor habitat. This produced a list of 26 bays and 3 coastal areas for data collection that would be the most beneficial from a commercial and government perspective.<sup>64</sup> The programme gathers predominantly hydrographic data, with a minimal number of sediment samples also collected to inform habitat maps.

INFOMAR surveys are conducted by a fleet of inshore survey vessels, each fitted for MBES surveying and sediment sampling. The programme can also access larger vessels for performing deeper water surveys. The survey programme is coordinated by a management team of three individuals, with a further three people supporting the geological data collection planning process. Survey work is then predominantly undertaken by a team of specialist in-house staff and contractors, with projects taking place for most the year aside from a few months during the winter. INFOMAR do not engage in commercial work or tender for projects.

All raw data and reports collected during the programme are made publically accessible via the INFOMAR website.<sup>65</sup> Raw data products include:

- bathymetry grids;
- backscatter grids;
- gravity grids;
- magnetics grids; and
- vector data at ground truth locations.

INFOMAR is well regarded within the international community as a successful national coordinated seabed mapping programme, which has been able to engage the Irish population in marine management issues. INFOMAR is also aligned with MCA's CHP and have together twice successfully delivered INTERREG projects that have boosted national survey efforts under their respective programmes. Finally, an increase in public awareness of Irish marine issues has been observed as a result of the project, this has been achieved through engaging local schools in marine mapping activities.<sup>66</sup>

---

<sup>64</sup> <http://www.infomar.ie/surveying/BaysMap.php>

<sup>65</sup> <http://www.infomar.ie/data/>

<sup>66</sup> <http://www.infomar.ie/EODP/EODP.php>

In addition to the benefits, it is also worth noting the potential constraints of the INFOMAR project.

Firstly, there is the potential lack of expert staffing resources to deliver the work in the near future. Many of the staff currently involved with the project will retire before the end of the 20-year period. Because the skillset required for mapping activities is not widely available, international recruitment may be necessary to keep the project running, although this is further limited by the fact that staff safety certification from overseas may not be accepted.<sup>67</sup>

Secondly, achieving INFOMAR’s aim of mapping the entire Irish seabed and its shores is constrained by the fact that many coastal areas are designated as sanctuaries for marine mammals, so there are specific requirements for the way in which surveys can be undertaken and limitations to the time of year during which they can take place, due to breeding seasons.<sup>68</sup>

### Case Study: Forecast and Evaluation of Economic Impacts of INFORMAR

A PwC report (2008)<sup>1</sup> has sought to place a value on the potential full-economy impacts of the programme by estimating the potential impact on sectors which the programme had the capacity to support.

Table 3-3 outlines the report’s forecasts of INFOMAR’s impacts by sector.

**Table 3-3: Forecast of INFOMAR Impact (to 2026)**

Forecast INFOMAR Impact (2013)	Low Scenario	Medium Scenario
<b>Commercial</b>		
Fishing Sector	€47.7 million	€95.4 million
Aquaculture	€28.9 million	€57.8 million
Biodiversity	€5.6 million	€11.1 million
Renewable Energy	€20.0 million	€40.0 million
Energy Exploration	€24.7 million	€49.3 million
Aggregates Industry	€42.7 million	€85.5 million
<b>Knowledge Economy</b>		
Research	€5.1 million	€10.2 million
<b>Legislative</b>		
Non-compliance Fines	€3.7 million	€7.5 million

The ex-ante assessment also predicted unquantified benefits. These are summarised in

Table 3-4.

<sup>67</sup> Ibid.

<sup>68</sup> Ibid.



**Table 3-4: Summary of INFOMAR’s Predicted Commercial Benefits by Industry**

Sector	Potential Benefit
Fishing	<ul style="list-style-type: none"> <li>• Efficiencies in fishing effort</li> <li>• Reduction in gear loss</li> <li>• Ability to identify and protect fish spawning and nursery areas</li> </ul>
Aquaculture	<ul style="list-style-type: none"> <li>• Selection of appropriate sites for cultivation</li> </ul>
Biodiversity	<ul style="list-style-type: none"> <li>• Mapping/identification of commercially exploitable species e.g. seaweed</li> </ul>
Energy	<ul style="list-style-type: none"> <li>• Identification of suitable locations for wind farms</li> <li>• Offshore oil industry site studies</li> <li>• Cables and pipeline routes</li> <li>• Tidal energy</li> <li>• Wave energy</li> </ul>
Aggregates	<ul style="list-style-type: none"> <li>• Potential commercial value of utilisation of marine aggregates</li> </ul>
Tourism/Leisure	<ul style="list-style-type: none"> <li>• Development of sailing routes/angling/diving</li> </ul>

It should be noted however that the methodology followed by the PwC report estimates the economic contribution of INFOMAR against the backdrop of no pre-existing seabed mapping surveying. **Therefore these benefits are considered an overestimate of what could be achieved via a national programme in the UK as there is no indication that seabed mapping would cease to exist in the UK.**

### Evaluation of the Impacts

An independent evaluation of the INFOMAR project by PwC determined that the economic benefits of the programme have been more muted than anticipated, reflecting the drastic change in the Irish economic circumstances. However, the evaluation determined that the data derived from INFOMAR was directly providing economic benefits to a number of commercial industries including:

- fisheries;
- aquaculture;
- renewables;
- oil and gas; and
- aggregates extraction.

A summary of the unquantified benefits associated with INFOMAR is shown in Table 3-5.

**Table 3-5: INFOMAR Benefits by Sector**

Sector	Programme Activity
Fishing	<ul style="list-style-type: none"> <li>• Inclusion of data in OLEX and SODENA Fishing Navigation systems</li> <li>• Use of seabed classification as physical habitat maps</li> <li>• Use of data by MI Fishery research / catch calculations group</li> <li>• BIM use of data annually in seed Mussel evaluations</li> </ul>

<b>Aquaculture</b>	<ul style="list-style-type: none"> <li>• Use of data in UISCE Project, BIM Aquaculture modelling including Killary Harbour</li> <li>• Collaborative project, mapping with BIM on Deepwater Aquaculture</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>• Use of data in designating new Offshore SACs over Geogenic reefs, in collaboration with NPWS</li> <li>• Use of data in decision process for Marine Strategy Framework directive and Marine Atlas</li> <li>• Inclusion of data in National Biodiversity centre under INFOMAR applied Research Project</li> </ul>
<b>Energy</b>	<ul style="list-style-type: none"> <li>• Surveying of suitable locations for national renewable energy test sites</li> <li>• Collaborative mapping of potential sites for WestWave project</li> <li>• Use of data by offshore operators/licence applicants in renewable sector</li> <li>• Input into cable and pipeline crossings in Irish sea</li> <li>• 5 renewable energy research projects funded</li> </ul>
<b>Energy Exploration</b>	<ul style="list-style-type: none"> <li>• Data fed into recent Strategic Environmental Assessments</li> <li>• Use of data in pre-drilling site evaluations for Oil &amp; Gas Companies.</li> <li>• Use of data by large energy company in exploration work.</li> </ul>
<b>Aggregates</b>	<ul style="list-style-type: none"> <li>• Limited, given collapse of the construction industry</li> <li>• Discussion ongoing with Irish developer for export to UK mar</li> </ul>
<b>Tourism/Leisure</b>	<ul style="list-style-type: none"> <li>• Inclusion of data in Coastal Heritage Web Viewers (Heritage Council)</li> <li>• Tourism products developed through the Atlanterra Initiative (InterReg)</li> <li>• Participation of vessels in outreach; the Tall Ships in Waterford &amp; Dublin, Volvo Ocean Race events, Cork port open day etc.</li> </ul>
<b>Research</b>	<ul style="list-style-type: none"> <li>• INFOMAR Applied Research Programme</li> <li>• Partnering on SME and campus company developments</li> <li>• Use of data in non-INFOMAR funded research internationally</li> <li>• Development of new marine research capacity in Ireland at certain third level colleges e.g. DCU in Marine geochemistry, NUIM in Marine Data Processing</li> <li>• Recruitment of Irish and international scientists on INFOMAR and externally funded marine research projects.</li> <li>• Facilitation of INFOMAR staff participation in INFOMAR related research (1 PhD, 3 MScs earned and 1 PhD and 2 MScs pending)</li> </ul>

Like the ex-ante assessment undertaken, the impacts are measured against the backdrop of no pre-existing seabed mapping surveying. Thus, it is unclear whether the benefits might have occurred in absence of the national programme, whereby seabed mapping activity takes place outside of a national programme framework.

### 3.4.3 Pacific Regional Hydrography Survey and Maritime Charting Initiative (New Zealand)

The Pacific Regional Hydrography Survey and Maritime Charting Initiative is led by Land Information New Zealand (LINZ) in partnership with the Geoscience for Development Programme at the Secretariat of the Pacific Community (SPC-SOPAC). The project is due to run from 2016 to 2019 and its initial focus will be in Tonga, Cook Islands, Niue, Samoa and Takelau with the view to extending to the rest of the Pacific. The regional programme aims to ensure navigational charts within the Pacific region meet international standards and support maritime safety and economic growth. It will be

focused on hydrographic data collection, as well as supporting regional development of maritime administrations and hydrographic capacity.

It is estimated that improvements to transport and infrastructure services will enable growth of international maritime transport and tourism, and create new opportunities for economic development throughout the region. It will help the development of mitigation measures for at risk maritime areas, such as improved navigation aids, and will deliver hydrographic risk assessments and surveys of significant and heightened areas of risk through improved paper maritime charts and electronic navigation charts.

The initiative is primarily funded through the New Zealand Aid Programme with a baseline budget of US\$4.4 million.<sup>69</sup> The programme will also develop additional collaborative partnerships and seek other funding mechanisms, including donors and the private sector. The survey work will be completed by private sector vessels, but will also include surveys carried out by the New Zealand and Australian Naval Defence Forces while on Pacific operations.

This initiative builds on a successful project in Vanuatu under which hydrographic surveys were conducted of four key Vanuatu cruise ship destinations. This unique proof of concept partnership with SPC, the Government of Vanuatu, the International Hydrographic Organisation and LINZ has recently produced updated marine survey charts and Electronic Navigation Charts to permit compliance with the International Maritime Organisation (IMO) regulations, and allow the continuance of cruise ship visits to these islands. Evaluation studies of the Vanuatu mapping programme predict that for every US\$1 spent on hydrography, there will be an estimated US\$91 return in ongoing economic activity.<sup>70</sup>

## 4.0 A UK National Seabed Mapping Programme

---

This scoping study has sought to examine the options for a national programme, in terms of potential delivery models (i.e. priorities, geographical scope, frequency of activity, equipment and technologies, methods of survey, type of data captured, outputs), as well as potential sources for financing and managing it.

Furthermore, using the information gathered, the study has attempted to quantify the economic, business and technological benefits of a national programme that would

---

<sup>69</sup> <https://sustainabledevelopment.un.org/partnership/?p=7936>

<sup>70</sup> Secretariat of the Pacific Community and New Zealand Ministry of Foreign Affairs and Trade Aid Programme, 'Assessing the Costs and Benefits of Hydrographic Survey and Charting - A Case Study of Vanuatu'.

provide consistent, high-quality data by the appropriate means, as well as the programme's associated costs.

As part of the interview process, which took place predominantly at the beginning of December 2015, 14 individuals from private sector organisations and 16 individuals from public sector organisations were consulted. The full list of organisations contacted for the interviews, including the ones which contributed to this study, can be found in Appendix A.2.0.

In the following sub-sections a summary of the outcomes of the interviews is provided.

## 4.1 Public Sector Interviewees

### The Need for a National Programme

There was a general consensus amongst the public sector interviewees regarding the need for and potential benefits of a UK national seabed mapping programme. A large number of public sector organisations are currently involved in mapping surveys or benefit from seabed mapping data in some capacity, and as a result many public organisations are already attempting to pool resources and coordinate further survey work.

In particular, many groups perceive that initiatives such as the Defra-MCA MoU and Civil Hydrographic Annual Seminar have been helpful in coordinating activities in the absence of a national programme. The increased availability of information via the MEDIN DACs, MAREMAP and the MDE have already been hugely beneficial to many sectors' activities, with data being frequently accessed. Some individuals remarked on how the open sharing of data and resources has been hugely beneficial already and therefore increasing the data being generated would likely deliver additional benefits.

In response to why a national programme might be necessary, interviewees noted that it would potentially lead to greater communication and coordination between programmes, which could save money and further prevent duplication of surveys. Furthermore, survey data collected under a national programme would likely conform to the same standards and be made available for use more widely than at present. Currently, regularly collected data may conform to different standards and therefore cannot always be used more widely, even if it is accessible. While there have been efforts by the public sector organisations to improve communication and coordination between them, it would be beneficial if survey plans were more widely known as early on in the process as possible, so resources could be shared and opportunities to synchronise activities could be identified.

A number of organisations discussed that they were willing to combine resources for surveying, but plans are not shared early enough under the current system to be able collaborate. Apart from the CHP, none of the other programmes within the public or private sectors have clear medium or long-term plans in terms of priority survey areas, which was understood to hamper effective forward planning.

It was also expressed that a seabed mapping programme will allow for better management of the seabed and help de-risk investment opportunities, increasing the number of potential development opportunities for offshore developers. It is also likely to result in accelerated activities (i.e. planning and licensing) due to the availability of more and better quality data. It can therefore be valuable to a range of activities including fisheries, marine conservation, marine archaeology, maritime landscape, marine spatial planning, renewables, hydrocarbon, cabling and oil and gas. However to do so, a programme should be wide in its focus (i.e. covering hydrographic, geological, environmental and biological), focusing on both shallow and deeper areas and prioritising areas with significant competition for space across the UK such as the Irish Sea, Greater Thames, Wash and Bristol Channel. Furthermore, any national programme will need to prioritise the areas for mapping across the devolved administrations (i.e. England, Scotland, Wales and Northern Ireland), to ensure that each area's requirements for seabed mapping are being met.

### **Potential Sources of Funding**

The discussion regarding potential sources of funding for a national programme centred on this being predominantly government spending. In addition, it was noted that in the past some organisations have had success applying for European funding such as the INTERREG IV (A, B and C) programme (e.g. MCA for the Ireland, Northern Ireland and Scotland Hydrographic Survey (INIS Hydro) Project, which was completed in March 2014), or collaborating with other European Union nations (such as the MCA and Northern Ireland under PEACE III<sup>71</sup>). Bidding for European funds may provide a means to acquire additional funds to target specific areas of interest, but this source of funding would only supplement a baseline budget that would be predominantly publically funded.

An additional option could be supplementing any national and European funding with contributions from industry and non-governmental organisations (NGOs) for specific targeted projects that might also interest these stakeholders.

### **Programme Management**

Most organisations responded that a national programme would need to be coordinated by the public sector. A number of organisations who are currently heavily involved in data collection were mentioned as being well positioned to coordinate a national programme, as were existing committees and groups which are involved in seabed mapping. However, many individuals expressed caution with just one government body

---

<sup>71</sup> The PEACE III Programme was a distinctive programme part-funded by the European Union (€225 million from the EU with further national contributions of €108 million) through its Structural Funds programme. The full title of the PEACE III Programme is the EU Programme for Peace and Reconciliation in Northern Ireland and the Border Region of Ireland. The programme covered the period 2007-2013 (<http://www.seupb.eu/programmes2007-2013/peaceiiiprogramme/overview.aspx>).

leading such a programme, as balancing the needs of various stakeholders may be complex. Successful international seabed mapping programmes such as INFOMAR and MAREANO have adopted a joint management approach, where a number of key stakeholders are involved. Therefore, any UK national programme would benefit from joint management and regular engagement from the various stakeholders through stakeholder working group meetings or other forms of consultation in order to coordinate survey work.

### **Equipment and Technologies Needed**

Without defining the priorities or timeframe for completion of a national seabed mapping programme, many interviewees were not able to comment on the equipment and technology that would be needed. Many discussed the significant marine surveying capacity already present within the UK, both within the public and private sectors, and believed that additional equipment and vessels may not be required. Where a shortfall in survey capacity exists, there may be the potential to coordinate with academic institution vessels, or even engage and train fishing vessels operators to meet the increased demand, thereby lowering costs.

A common issue raised was the need to collect data to the same standards in order to meet all stakeholders' needs. As surveys are currently performed using a range of equipment to different specifications this may require some survey vessels to be able to change their equipment or update the technology being used to ensure that the data being collected can be used for a variety of purposes.

It was also expressed across interviewees that a national programme could help advance progress made with AUVs for deep waters, as these technologies are likely to transform current practices and lead to cost efficiencies.

### **Priority Areas**

There was some discussion regarding the priorities of a national programme and whether these would be exclusively set by the body/bodies managing and/or funding the programme. As this would likely influence how the different stakeholder interests were being prioritised, it would be a key area of concern. Therefore, some individuals suggested that the priorities of a national programme should, in the very least, incorporate all the priorities of existing programmes (such as the CHP and the MSFD) with legal requirements. The devolved administrations also emphasised the need for the priorities of each country to be considered under the national programme, rather than focusing heavily just on one.

The majority of interviewees from the public sector noted that the collection of full coverage MBES data was determined to be of the highest priority. This is because it provides high resolution data that has wide applications. However, some interviewees expressed their concerns about a national survey programme that was overly focussed on MBES collection, as this would not meet all stakeholder requirements. Across interviewees it was noted, however, that different types of data would need to be collected, whether that's hydrographic, environmental, geological or biological.

As hydrographic surveys in deep water are more cost-effective than in shallow inshore areas, the INSS produced a highly successful and cost-effective programme by prioritising territorial waters furthest from the Irish coast. This led to rapid data acquisition and proved the financial benefits of a national seabed mapping programme. However during the interview process, a number of public sector organisations cautioned against such an approach if a national UK seabed mapping programme was to go ahead. Considering the majority of industry development projects and human interaction with the marine environment occurs in the inshore and coastal waters, prioritising these areas first might be most beneficial to the commercial sector, as well as to conservation organisations, rather than going further offshore.

Collecting baseline data where there is the greatest concentration of development processes was also suggested. This would include areas such as the Thames Estuary, Bristol Channel, the Irish Sea and the Wash. Finally, it was noted that gathering more information on MPAs, SACs and Marine Conservation Zones (MCZs) would be very beneficial for conservation purposes.

### **Main Outputs**

The main points of a national programme noted during the interviews were related to data collection. It was widely mentioned that data should be available free of charge and easily accessible given that currently it is often unknown whether data already exists. Whether free access is a viable option for all types of data would need to be explored further. It could be that raw data and metadata is made publically available free of charge and any value added derived products and interpreted data, such as high resolution maps are available at a cost.

Most organisations would like to see the national programme have a centralised data hub, where all available data can be accessed in an intuitive format. For example, the INFOMAR project has been celebrated for making all data collected during the programme freely available, as this has been shown to stimulate developments within the commercial sector.

A number of groups raised concerns regarding what type of data would be the most beneficial. In general, survey data in its raw form would be preferable, as it would allow the data to be manipulated by different users to satisfy different needs. However, certain data types, such as MBES raw data, can be time-consuming to process and often require specialist staff or software to process it into a format that can be used by third parties. Other organisations expressed a preference for finished products such as high resolution sediment and habitat maps or high resolution images, where the interpretation has been performed by specialist staff, to be the outputs of a national programme, beyond just raw data or metadata. Value added products are more likely to be widely used across industries and will be able to inform various activities, from educational purposes to offshore developments.

What is likely to occur under a national programme is an increase in the influx of high-quality data being collected, which will require considerable storage space to archive (in the form of web-based clouds or data centres) and that is likely to be at an increasing

cost. It was therefore identified as critical that any national programme has a separate budget for data management and storage.

### **Benefits and Opportunities**

Most public sector organisations interviewed recognised the potential benefits a national programme could provide to their current operations. The most common benefits suggested during the interview process were:

- allowing for more informed decision-making;
- providing cost savings to current survey budgets;
- reducing the overlap of surveying even further;
- accelerating the pace of activities, such as licensing and planning;
- further improving the sharing and accessibility of data; and
- allowing the focus of survey work to become more targeted and multifaceted to satisfy many needs concurrently.

Some public sector organisations with close links to private industry identified the de-risking of investment as a major benefit of a national programme, as it would essentially provide the baseline data for a number of areas, thereby accelerating development. It is thought that a national seabed mapping programme may stimulate more large-scale development projects, as new potential sites may be identified with limited risk. Interviewees noted that many industries could benefit from the data collected and made available by a national programme.

### **Risks and Challenges**

The main risk raised by the public sector organisations was how a national programme would balance the needs and priorities of different stakeholders, whilst still collecting high quality data to a level of detail that would satisfy all parties. Certain stakeholders believe that some survey objectives are so unique in nature that they would be unlikely to be accommodated under a national programme with a standardised survey process. This would mean that regardless of the existence of a national programme, there may always be a need to commission bespoke seabed mapping surveys focusing on specific needs.

Furthermore, organisations operate in different ways, and coordinating those differences under a national programme would be a major challenge. Certain organisations, for example, require a flexible survey plan in order to respond immediately to certain needs, and maintaining that flexibility would be difficult under a national programme.

Another concern raised by a few of the interviewees was the ability of a national programme to have access to the latest technology at any given point, particularly considering how quickly technologies are evolving. For example, the resolution specifications surveys abided by currently, might be outdated in ten years' time. Due to funding constraints, it is possible that the national programme may not be able to adapt or be updated as quickly as separate organisations might be able to do so.



Finally, how data will be managed and shared will be another challenge of a national programme. How this will be funded, which organisations will own the data and who will be responsible for archiving and maintaining all archive centres will also need to be resolved.

## 4.2 Private Sector Interviewees

### **The Need for a National Programme**

There was unanimous support for a national seabed mapping programme across the private sector organisations interviewed as part of this study. There were, however, contrasting views of what this might look like. Whilst some interviewees envisaged that a national programme would focus on the collection of baseline data to de-risk investment and remove the onus from developers, others felt that it might concern only the collation, management and sharing of data that had already been collected separately by various organisations.

### **Potential Sources of Funding**

Interviewees were asked whether they were aware of any potential sources of funding for a national programme. Although no potential sources were identified, the general consensus was that funding should come predominantly from the public sector. With private organisations already collecting large quantities of data – which they were broadly willing to share as part of a national programme, assuming no commercial sensitivities – the feeling was that industry would be reluctant to contribute financially to the running of a national programme. This may also be attributable to the sense that a national programme would be unlikely to fully replace their current survey activities and thus the provision of funding would be seen as an additional cost.

### **Programme Management**

Interviewees emphasised the importance of collaboration between the public and private sectors with regards to the design and management of a national programme. In the interest of ensuring the programme delivers maximum value for money, this would mean that the data needs of all stakeholders should be considered, be it bathymetric, environmental and/or geological.

It is understood that this has taken place already, albeit in silos of coordination amongst stakeholders. The Marine Aggregate Levy Sustainability Fund was able to fund the design of a series of surveys effectively; through the Regional Environmental Characterisation Surveys. They were undertaken primarily to develop a better understanding of submerged habitats and heritage in Britain. A multi-disciplinary selection of stakeholders across public and private sectors were responsible for the design of the surveys, with the nature of the group making it much easier to agree the terms of reference and outcomes that were required.

Interviewees considered there to be a need for a central database that would collate the survey data already collected across the public and private sectors. This would go some way to reducing the amount of work that is currently being duplicated because of the

lack of effective communication, and preventing data from “going to waste”, as some interviewees considered was currently the case. It was suggested that this could be managed by an existing organisation, such as the UKHO, BGS, MCA, Cefas or academic bodies such as the National Oceanography Centre (NOC) in Southampton. Interviewees commented that there was already a lot of infrastructure in place, such as MEDIN and MAREMAP, and that adapting an existing database may be a more effective and efficient use of resources than building a new one from scratch.

One interviewee commented on the importance of data standardisation, especially if data was to be collected by a range of organisations using different equipment. MEDIN quality standards were cited as a good example of this being done in practise. Other options would be the standard used by the MCA and Cefas; IHO S44 Order 1a.

There were varying thoughts across the interviewees on whether or not data collected as part of the national programme should be available free of charge. Some felt that if the programme was going to be managed publically, then any survey data collected should be available for free. Others suggested that a small handling fee could be applied, or that data of a lower resolution could be provided free of charge, whilst higher resolution data or value added products (e.g. nautical charts) should be available at a cost. An alternative suggestion was that raw data might be provided for free, with any analysis available at a cost.

### **Equipment and Technologies Needed**

The interviews did not identify any particular equipment or technologies that might be required as part of a national programme. Participants did emphasise, however, the need for a programme to collect as much data as possible to ensure its value across a wide range of stakeholders. To do so, a range of equipment and technologies would be required, to satisfy varied data needs (e.g. bathymetric, environmental, geological, biological, etc.).

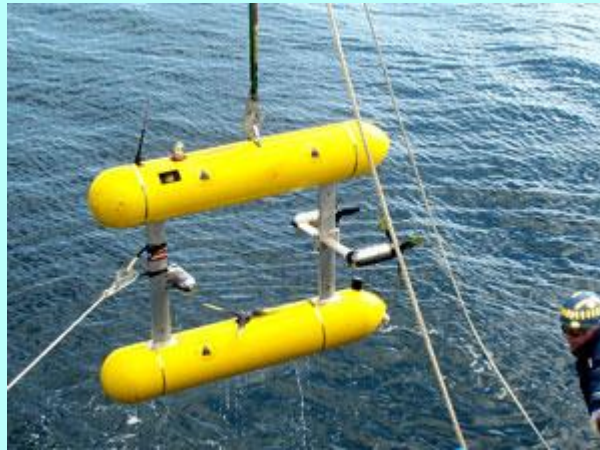
## Case Study: Innovation in the Marine Sector - Autonomous Underwater Vehicles <sup>72</sup>

---

<sup>72</sup> NERC, 'Science Minister Opens Marine Robotics Innovation Centre', 24 November 2015, <http://www.nerc.ac.uk/press/releases/2015/15-johnson/>.

Autonomous Underwater Vehicles (AUVs) are unmanned vehicles that can move through the ocean without real-time input from a human operator.

AUVs have a wide range of applications in the marine environment, and are increasingly being seen as a technology that has the potential to have a significant impact on the way seabed data is collected. Its application in this area could bring about significant economic benefits by reducing the time and costs associated with collecting data. Some sectors – notably the oil and gas industry – view AUVs as a solution by which to increase the efficiency of its operations; especially important given the pressures currently facing the industry in the context of low oil prices.



The SeaBED autonomous underwater vehicle. Credit: NOAA Pacific Islands Fisheries Science Centre

The oil and gas industry is in the process of researching the application of the technology. In 2015, Shell announced the launch of the \$7 million Shell Ocean Discovery XPRIZE, a three-year global competition challenging teams to advance ocean technologies for rapid and unmanned ocean exploration. BP have partnered with the National Oceanography Centre on their £3 million centre to develop new technology for the emerging marine robotics sector. Further to this, NERC, Innovate UK and the Defence Science and Technology Laboratory (DSTL) plan to invest over £13 million in Small Business Research Initiative projects. It has been reported that the first of these projects has led to the development of two innovative autonomous surface vehicles that are now operating at a commercial level.

A UK national seabed mapping programme could help focus this attention, providing a platform for demonstrations, competitions and showcasing which could lead to marketable products and services being developed and exported, contributing to the Government's growth agenda and export targets to economic growth.

### **Priority Areas**

In order to maximise its value, interviewees were asked what they thought the priorities of a national programme should be. Responses were varied, as understandably each sector operating in the marine environment has their own areas of interest. Some interviewees suggested that the focus should be on areas that provide the greatest

socio-economic benefit to the UK. Others suggested that a national programme should collate data that is already available and attempt to fill any gaps. Alternatively it was noted that the MCA was effective at identifying areas that need to be urgently surveyed and therefore that responsibility could be assigned to them.

Other interviewees suggested that there should be a focus on MCZs, designated under the Marine and Coastal Access Act 2009, for the purposes of protecting a range of nationally important marine wildlife, habitats, geology and geomorphology. It was felt that existing data collected for this purpose was of poor quality, with significant gaps existing across the UK designations.

### **Main Outputs**

All interviewees wanted to see improved accessibility to survey data through the introduction of a central database or web portal. Some offered suggestions for additional functions, such as designing the database in such a way that data could be linked with WebGIS. This would allow the data available through the national programme to be combined with data from other sources. Another suggestion was that it could link with current products such as Google Earth.

A further suggestion was that a central dataset should be easily accessible and user-friendly, so that the general public could use it.

### **Benefits and Opportunities**

The interviewees identified a number of economic benefits that might be associated with the introduction of a national programme. It was broadly agreed that the principal economic benefit would be a reduction in the time and money spent by industry on collecting survey data separately. This might be with regards to commercial or regulatory purposes.

With regards to the former, a national programme could potentially de-risk investment and better inform sub-sea developments through the provision of accurate baseline data. By way of an example, interviewees noted that the introduction of a national programme might allow the industry to identify better cabling routes. Currently the dearth of available data means that routes often have to be plotted close to other cables for which data has already been collected.

A national programme might also reduce the administrative burden associated with regulatory compliance. In the context of the aggregates industry, for example, data collected as part of a national programme may reduce the amount of data collection required by their operators in order to fulfil the compliance requirements associated with a marine licence for aggregates extraction. It was, however, generally felt that a national programme was more likely to compliment industry's survey activities rather than replace them in whole.

In a social context, a national programme might lead to improved navigation and therefore greater levels of safety. It was also noted that academics and research institutions would be likely to find that data useful for their own research.

It was also noted that, assuming the data was publically owned, a national programme might act as a stronger tool for Government to manipulate markets. It could provide Government with opportunities to put forward potential projects directly rather than depend on the funding available from a developer, which will solely dictate needs.

It was generally felt that the benefits associated with a national programme would be felt across the range of industries operating in the marine environment; interviewees did not identify any particular sectors that they thought might benefit from the introduction of a national programme significantly more than others.

### **Risks and Challenges**

A key challenge associated with the introduction of a national programme is ensuring that it delivers value for money. With this in mind, interviewees were keen to stress the need for the scope of the data collection to be kept broad to accommodate different stakeholders' needs. At the same time, interviewees commented that data shouldn't be over-specified, as this would be costly to collect. It was felt that the specification should fit with the ultimate end-uses, which needed to be clearly defined at the outset.

Indeed, interviewees commented that the cost of a national programme should not be underestimated - managing, storing and sharing a greater volume of data is likely to require a lot of time, effort and cost.

Another challenge might relate to how often areas of the seabed are re-surveyed. If environmental data was to be collected, the national programme would need to decide how often this was to be done, especially given that the environmental characteristics of the seabed can change rapidly. Developers that need up-to-date information to feed into EIAs might not buy into the idea of a national programme if the data it provided was not of the requisite temporal resolution.

Depending on the specification of a national programme, one challenge might lie in convincing organisations to make their data publically available. It was suggested that some thought could be given to how to make it worth their while. Another challenge to the effective use of a national database might relate to addressing the incorrect use of metadata. One interviewee considered that the entry of metadata to MEDIN was an "afterthought" to many users. This affects the utility of the data itself (as without key words it is considered difficult to search and find the right information) and is an issue that stakeholders have voiced concerns over in a recent review of access to industry survey data by ABPmer for the Productive Seas Evidence Group (2015).<sup>73</sup>

Finally one interviewee commented on the issue of liability. For example, if an organisation provided data to a national programme that was then made publically available, this data might then be used for navigational purposes. If this data transpired

---

<sup>73</sup> Productive Seas Evidence Group, ABP Marine Environmental Research Ltd, and Peter Barham Environmental Ltd, 'A Review of Access to Industry Marine Environmental Data'.

to be inaccurate and a vessel using it was damaged, there might be a question mark over who should take responsibility. Under the International Maritime Organisation's Marine Pollution (MARPOL) Convention, governments may be liable to pay for clean-up and compensation if a significant accident (such as an oil spill) were to occur due to poor hazard mapping. With a national programme, roles and responsibilities and legal liabilities should be clearly stated.

## 5.0 Options for a National Seabed Mapping Programme

---

Whilst there is a clear difference of views between different stakeholders on the precise detail of a national programme, there were common criteria that a programme should include. These can be summarised as follows:

### Where and What to Survey

- Avoid unnecessary duplication of survey effort between public sector, and where possible private sector operators.
- The data needs of all stakeholders should be considered, be it bathymetric, environmental, geological or biological.
- Recognise that bespoke seabed mapping surveys will always be needed, but even so data should be collected to a common standard in order to maximise re-use.

### How to Survey

- Procure a range of equipment, technologies and services, to satisfy varied data needs.
- Data should be collected to a common agreed standard in order to maximise re-use.

### Access to the Survey Data

- Open sharing of data and resources.
  - Provide a central database that would collate the survey data already collected across the public and private sectors.

Based on the findings outlined within Sections 3.0 and 4.0, several delivery options for a national seabed mapping programme were considered. These options were assessed and most were eventually discounted due to a number of reasons, as outlined in detail in Section 5.4. Two potential delivery options alongside the baseline were developed in detail, which are outlined in the following sub-sections. It should be noted that these options are provided at a scoping level – enabling an indicative assessment of the relative cost and benefits of each of the options. Additionally, it should also be recognised that these options are not exclusive of one another, and could be interchangeable from one year to another.

For both options there would be an expectation that as benefits are realised and an evidence base for increased mapping activity is built up, the programmes would expand and develop in to full and comprehensive mapping programmes with the end goal of mapping the entire UK Continental Shelf. This progressive model mirrors that seen in the formation of other successful national programmes such as INFOMAR and MAREANO.

Table 5-1 provides a summary outline of the different features of each option considered, including the baseline.



**Table 5-1: Summary of Options for Seabed Mapping Programme**

Theme	Activity	Baseline	Option 1- Light	Option 2 – Full
<b>Coordination</b>	Front end coordination of survey activity	Conducted on an ad-hoc basis	Only existing and new areas identified as being of significant need i.e. identified as commercially, environmentally and scientifically important and where a significant risk of surveying duplication exist	All surveying activity
	Back end coordination of data sharing	Some coordination, but largely limited to signatories of the MoU	All data shared	All data shared
<b>Governance</b>	Organisation responsible for mapping activity	Multiple organisations	A single national mapping organisation, with support from other organisations	A single national mapping organisation, with support from other organisations
<b>Interaction with Private Sector and other interested</b>	Declaration of mapping priorities	Not uniformly announced	Will be announced by national mapping organisation	Will be announced by national mapping organisation

Theme	Activity	Baseline	Option 1- Light	Option 2 – Full
parties	Interaction between public and private mapping	Isolated occurrences	<p>Will be recommended by national mapping organisation.</p> <p>Incentives for improving interaction can also be explored such as setting up a financing facility whereby the national programme would contribute to some of the private sector survey costs on condition that the data collected is relevant to the national programme, it meets a defined standard and can be made openly accessible.</p>	<p>Will be recommended by national mapping organisation.</p> <p>Incentives for improving interaction can also be explored such as setting up a financing facility whereby the national programme would contribute to some of the private sector survey costs on condition that the data collected is relevant to the national programme, it meets a defined standard and can be made openly accessible.</p>
	Availability of data	Some data released publically	All data released publically	All data released publically
	Technology and Data	Use of the latest available technology	Only where requested by individual organisations	Will only be deviated from by exception
Use of Common Data Standards		Collected in different standards	Collected to a common standard	Collected to a common standard

## 5.1 Baseline: Maintain Status Quo

This option reflects the baseline or current scenario in the absence of any intervention: a continuation of the status quo. If there was no national seabed mapping programme, all seabed mapping activities currently being undertaken by various public and private stakeholders on a separate, isolated basis would continue to take place over the next decade. There will continue to be a limited amount of data sharing and coordination among those stakeholders. Pockets of data sharing and coordination would continue to exist such as for example, amongst public bodies that are signatories to the MCA and Defra Memorandum of Understanding (MoU), members of platforms such as MEDIN or The Crown Estate's Marine Data Exchange, databases specific to industry sectors such as the UKBenthos database for oil and gas, and so forth. Furthermore, technologies and equipment deployed for surveying and the quality of the data collected will be governed by the requirements of end users and the capabilities of the relevant data providers, and will not be formally standardised i.e. it will not all be collected in accordance with standards such as IHO S44 Order 1a for hydrographic data.

The key advantages of this option therefore include:

- Lower capital investment required as opposed to alternate options; and
- Continued increase in coordination of activities and level of data provision at the current rate over the long term.

In addition, key disadvantages associated with the option are:

- Inconsistencies in quality and formats of data collected by the various stakeholders (unstandardized);
- Imperfect access to data across sectors and industries, sometimes resulting in inefficient outcomes (such as costly overlaps in survey activity, unnecessary navigational hazards, etc.);
- Difficulty associated with maintaining individual and isolated financing and technological requirements for each programme; and
- Limited integration of seabed mapping survey planning and delivery (predominantly restricted to the public sector) due to requiring time consuming coordination among stakeholders.

## 5.2 Option 1: National Programme - Light

Under Option 1, there would be a national seabed mapping programme coordinated by a single organisation or a partnership of organisations (or even a newly created body with combined staff from various interested parties).

The decision on where to map will be strongly focused on coordinating surveying activity in existing areas of significant need and any areas identified in the future as being of significant need. The definition of 'significant need' is likely to be based on areas where a national programme is needed to improve the coordination of activities – i.e. areas which are at risk of having duplicated surveying efforts conducted in them and areas identified by a national mapping organisation in collaboration with other bodies as

commercially, environmentally and scientifically important. It is assumed that these areas would be in addition to those which the UK has an obligation to map under the International Convention for the Safety of Life at Sea (SOLAS) for the purposes of navigational safety and other such obligations.

Thus, areas where the risk of duplicating surveying efforts is low (for example, in localities where there is less need to coordinate activity) and areas judged to be of low potential commercial, environmental or scientific importance are unlikely to be a strong focus of the decision-making aspect of the programme. Under this option these activities can still be affiliated to the national programme and undertake the collection and dissemination of data to the same standard and processes as surveying areas of significant need.

It is recognised that the identification and decision on the prioritisation of the survey areas of focus for this option is likely to be a difficult process, and is likely to require re-evaluation on at least an annual basis.

A central body would be responsible for delivering the national programme. It is anticipated that under this option there would be close collaboration between public and private sector organisations, with all the relevant stakeholders being active participants of the decision making process and the delivery of the surveying activities. The central body will be the single point of contact for private and public sector organisations to communicate and potentially partner on projects, therefore increasing coordination and transparency in the planning stages of surveys and avoiding unnecessary duplication of surveys (e.g. one survey could be used to gather different types of data).

Currently there seem to be instances where areas prioritised for mapping are surveyed multiple times due to lack of effective coordination among stakeholders in the planning stages and because existing data is not of the required quality or resolution. It is recognised, however, that even in this option some duplication of surveying is expected to continue to exist due to the need for some areas to be remapped or in circumstances where short notice of a mapping need arises.

It is acknowledged that there will always be a need for additional surveying to take place, particularly from the private sector, when specific data will need to be gathered in a specified timeline that the national programme might not necessarily align itself with. It is proposed that in order to improve efficiency between private sector organisations commissioning survey work and the national programme, a financing facility could be setup whereby the national programme would contribute to some of the private sector costs on condition that the data collected is relevant to the national programme, it meets a defined standard and it can be made openly accessible.

Another potential condition of claiming finance could be that private sector organisations must share information about any upcoming survey plans. Open communication and transparency can improve coordination between the private sector and the national programme, increasing access to data for all stakeholders and potentially reducing duplication of effort even further. The level at which organisations

can claim finance and the period of time during which such claims can be made by the surveyor will need to be determined if such a fund is setup, to ensure that the surveyors have an incentive to claim finance (i.e. that the amount of money being reclaimed does reduce the cost the surveyor would have incurred to undertake more survey work) and that the data being shared by the private sector is still relatively recent and thereby relevant for wider use.

It is assumed that any public sector savings achieved from avoided duplication of surveying due to improved coordination amongst stakeholders will be reinvested into further surveying activity (and could potentially contribute to the aforementioned fund as well). This will result in an increase in the volume of high-quality data being collected in areas prioritised for mapping; access to high-quality free data which will deliver direct savings to the public and private sectors. It should be noted that this assumption does not apply to any private sector savings achieved by the programme due to the fact that the private sector has no incentive to undertake further survey work beyond their needs. Instead, the assumption is that the private sector will realise direct savings to the cost of their business activities. In all cases, the surveying conducted under the programme will be required to meet a common standard and use prescribed technology and equipment, to maximise re-use.

The key features of this option are:

- The identification of areas of significant need on an annual basis and their prioritisation for mapping associated with key data requirements, objectives and benefits. This includes existing areas identified as valuable and any newly identified areas of value;
- The delivery of data quality for key areas that meets a formal standard across the board, using prescribed up-to-date technology (e.g. MBES);
- The reinvestment of public sector savings from the reduced unnecessary duplication of surveying due to improved coordination amongst stakeholders into undertaking additional mapping surveys, thereby increasing the volume of high quality data being collected; and
- Improved communication between the public and private sectors and an increase in potential partnerships, through the existence of a central body (i.e. single point of contact) that would facilitate the consultation and procurement processes and strong leadership from both ends.

Associated advantages arising from this option include:

- The availability of high quality, consistent and complete data for existing and new areas of significant need, which will be made available to all stakeholders;
- An increase in the quantity of data available. The public sector savings from avoided duplication of efforts is likely to enable new areas to be surveyed. These are likely to be focussed on the areas of significant need which are expected to deliver large amounts of benefits;
- Acceleration of activities (e.g. planning, licensing) and de-risking of potential investment due to the existence of better quality baseline data; and

- Incentives for further coordination and partnerships among sectors and existing stakeholders during the procurement of services and technology for surveying and monitoring.

Disadvantages that may be anticipated include:

- Any areas which have not been identified as possibly having duplicated efforts in surveying or of being of potential commercial, environmental and scientific value, either currently or in the future, will not be prioritised for surveying as part of the programme's core activities. Duplication of efforts could still occur if the identification and prioritisation of areas for mapping is inadequate;
- There is expected to be a larger administrative burdens associated with:
  - The establishment of an organisation to provide the decision making framework for the identification and evaluation of priority survey areas;
  - The involvement of numerous stakeholders to provide input in to the decision making process; and
- The potential for economies of scale in terms of capital investment in technology and skills across the UK is limited relative to Option 2.

### 5.3 Option 2: National Programme - Full

Under this option, there would be a national seabed mapping programme coordinated by a single organisation or a partnership of organisations (or even a newly created body with combined staff from various interested parties), and the survey activities undertaken will focus on all UK marine areas, not just those areas identified as being of significant need.

This option would not necessarily result in the entire UK continental shelf being surveyed, more that the scope of the programme would focus on all of the areas currently included in existing public sector programmes and private sector survey activities. Decision making on where to survey would consider all UK marine areas, rather than just the areas at most risk of duplication of surveying efforts and areas identified as being commercially, environmentally and scientifically important. As with Option 1, it is assumed that these areas would be in addition to those which the UK has an obligation to map under the International Convention for the Safety of Life at Sea (SOLAS) for the purposes of navigational safety and other such obligations.

It is anticipated that under this option there would be close collaboration between public and private sector organisations, with all the relevant stakeholders being active participants of the decision making process and the delivery of surveying activities. The benefit of this approach is expected to deliver reductions in duplication of survey activity and direct savings to the public and private sectors through the access to free data, similar to Option 1. This option seeks to build on Option 1 by ensuring that even areas that have not been considered to offer benefits of collaboration (e.g. areas which are not expected to deliver significant savings through avoided duplication or which have not

been identified as being of potential commercial, environmental and scientific important) would be included in the programme.

Like Option 1, it is expected that public sector savings from duplication will be reinvested in further survey activity, and that private sector savings will not be reinvested in further survey activity due their bespoke nature. Where it differs from Option 1, is that the reinvestment could take place in any of the marine areas rather than just in those identified as being a priority for duplication and areas identified as being commercially, environmentally and scientifically important. As with Option 1, it is assumed that these areas would be in addition to those which the UK has an obligation to map under the International Convention for the Safety of Life at Sea (SOLAS) for the purposes of navigational safety and other such obligations.

The benefits of mapping the unknown are by their nature, unknown. However, there is the possibility that new discoveries can be made in a range of fields by mapping the UK 'maritime frontier'.<sup>74</sup> Given the lack of concrete evidence of making such discoveries lower benefits might be achieved from the data derived from the reinvestment under Option 2 when compared to Option 1.

It is also recognised that under Option 2, as is the case with Option 1, that duplication of surveying will not be eradicated. There will continue to be a need for some areas to be remapped (e.g. when reviewing the sea depth around sand banks and other such areas over time as it is constantly changing or when applying for a licence prior to construction to satisfy risk and insurance concerns). Furthermore, it is expected that under both options there will always be a need for additional surveying to take place, particularly from the private sector, when specific data will need to be gathered in a specified timeline that the national programme might not necessarily align itself with. As proposed under Option 1, it is proposed that in order to improve efficiency between private sector organisations commissioning survey work and the national programme, a financing facility could be setup whereby the national programme would contribute to some of the private sector costs on condition that the data collected is relevant to the national programme and it meets a defined standard and can be made openly accessible.

Open communication and transparency can improve coordination between the private sector and the national programme, increasing access to data for all stakeholders and potentially reducing duplication of effort even further. The level at which organisations can claim finance and the period of time during which such claims can be made by the surveyor will need to be determined if such a fund is setup, to ensure that the surveyors

---

<sup>74</sup> The benefits of mapping the unknown are hard to quantify yet can be significant. For example, in 2014 the seabed mapping activity undertaken as part of the search for Malaysia Airlines Flight 370 was reported to have given scientists in Australia a better understanding of areas that during earthquakes are susceptible to underwater landslides, which can create or exacerbate tsunamis.

have an incentive to claim finance (i.e. that the amount of money being reclaimed does reduce the cost the surveyor would have incurred to undertake more survey work) and that the data being shared by the private sector is still relatively recent and thereby relevant for wider use.

Similar to Option 1, this option will result in an increase in the volume of high-quality data being collected as part of the national programme, that both the public and private sectors will benefit from through free access. In all cases, the surveying conducted under the programme will be required to meet a common standard and use prescribed technology and equipment, to maximise re-use.

The key features of this programme are:

- The coordinated and comprehensive work plan for seabed mapping across all public bodies, with the ability for private bodies to also contribute the coordination of activity;
- The delivery of comprehensive high quality data sets that meet a formal standard across the board, using prescribed up-to-date technology (e.g. MBES);
- The increased chance of avoidance of duplicating surveying efforts and the associated investment of any public sector savings in additional surveying activity;
- Acceleration of activities (e.g. planning, licensing) and de-risking of potential investment due to the existence of better quality baseline data; and
- Incentives for further coordination and strong partnerships among sectors and existing stakeholders during the procurement of services and technology for surveying and monitoring.

Additional advantages of this programme option are:

- Increased acquisition of new data in previously unmapped areas, with a high potential for new discoveries (e.g. hydrocarbon find, biotechnology discovery, avoidance of major costs from environmental disasters) and multiplier effects;
- Accelerated availability of better quality data, where required, leading to potential reductions in investment and navigational risk; and
- The availability of complete and consistent knowledge for planning and management of policies, programmes and projects.

The key disadvantages associated with this programme are:

- A higher administrative burden associated with coordinating all of surveying efforts;
- The risk that additional data being collected from unknown areas is of little or no value as it is not associated with priorities; and
- A challenging decision making process of where to focus additional survey efforts.



## 5.4 Proposed Options Considered and Discounted

As part of deciding which options to model under the cost-benefit analysis, a series of options were also discussed and either discounted or built in to the final options. These options are presented in the following points along with the reasoning of why they were discounted.

1. **Data Coordination:** A national programme that acts as a single entity to streamline and improve the dissemination and coordination of data amongst existing seabed mapping activity.

**Reasons for discounting:** While under this option there would be some improved coordination amongst stakeholders in sharing data, this option would not improve the coordination of deciding which areas to survey thus not reducing the unnecessary duplication of surveying activity.

2. **Paying for Data:** A national programme that establishes a centralised fund for paying existing and new seabed surveyors to claim finance, if they collect data to certain standards. Under this option, the decision on where and what to survey would be taken independently. On condition of claiming finances, surveyors would be required to collect data to a defined standard and make the data accessible and open.

**Reasons for discounting:** Collecting data to certain standards can help maximise re-use and thereby reduce unnecessary duplication efforts. However, some organisations are already collecting data to a high standard and therefore there will be some deadweight associated with paying these organisations. Finally it is not clear how the existence of a centralised fund could help improve coordination amongst stakeholders in the planning stages and thereby further reduce duplication efforts and subsequent reinvestment in surveying efforts. This option could not therefore have been modelled as a stand-alone alternative for a national programme, but the concept of the centralised fund has been built into the two options which have been modelled.

3. **Single type of National Programme:** A national programme that focuses on one specific type of seabed mapping only (e.g. one of bathymetric, environmental, geological or biological mapping services). This option would follow a similar approach to the Pacific Regional Hydrography Survey and Maritime Charting Initiative in New Zealand, which runs until 2019 and focuses only on hydrography data, primarily for navigational purposes.

**Reasons for discounting:** Any national programme that focused on one type of mapping only was discounted early on in the process due to the number of interviewees across the public and private sectors which expressed how important they thought it would be for any national programme to address the needs of the various stakeholders involved. That would mean carrying out

surveys that collect data to cover bathymetric, environmental, geological and/or biological mapping, as well as collecting high quality data to a specific standard to maximise reuse.

It is also worth noting that we have not modelled what the costs and the benefits of a national seabed mapping programme that will survey the entire UK continental shelf will be, as it is not possible to undertake such an assessment without having an understanding of what the needs of an all-encompassing programme would be (in terms of requiring geological, environmental and/or hydrographic mapping data). Given the fact that only ~30% of the UK seabed has been mapped thus far and there are many unknown areas for which we have very limited information, we do not currently have the evidence base across the public and private sectors that will be required to undertake such an assessment. We have therefore followed a similar rationale to that of other seabed mapping programme evaluations.<sup>75</sup>

---

<sup>75</sup> PwC, 'INFOMAR Marine Mapping Study - Options Appraisal Report: Final Report'.

## 6.0 Economic Assessment of National Programmes

---

In the following Section an assessment of the economic impacts associated with each of the options outlined within Section 5.0.

### 6.1 Baseline Assessment

The costs and benefits of the delivery options for a national seabed mapping programme considered in this economic assessment are measured against a baseline, represented by the status quo, or 'business as usual' scenario. This is, in effect, a forecast of how the relevant sectors will develop over a 10-year period (as is standard practice in cost benefit analysis) in the absence of a national seabed mapping programme. However it should be noted that any national seabed mapping programme would be expected to continue to be a national asset for well beyond this modelling period. Although the baseline signifies a 'do nothing' approach, considerable attention has been paid to the fact that decentralised seabed mapping activities are currently undertaken, and associated benefits are already being accrued.

Therefore, while studies reviewed as part of this project typically focus on an estimation of derived benefits (such as job generation and investment in research and development) arising from mapping programmes, against a counterfactual of no mapping being undertaken at all, this study develops an approach to estimate the additional benefits that would arise from implementing the programme against a counterfactual of existing mapping activity being undertaken, as is currently the case. Accordingly, the baseline assumes that existing programmes would not only continue to exist in the absence of a national seabed mapping initiative, but would continue to develop over the next 10 years given the impetus for greater coordination across the sector.

For the public sector, it is likely that reductions in central Government expenditure will occur. However, the need for seabed mapping activity will still exist and therefore it is estimated that the source of the money is likely to change with a reduction from central Government funding and an increase in research and scientific funding – especially from the European Union. The forecasts associated with the baseline scenario are made on best available evidence and in alignment with published Government policies and industry plans. However, given the length of time over which the baseline extends and the geographic scope of this analysis, there is uncertainty surrounding the assumptions and estimates used to define it. Exogenous factors cannot, by their nature, be accurately forecast and no attempt to include such effects is made within the economic model.

To mitigate against such factors, most macro-economic forecasting rarely aims to predict beyond a five-year time horizon, but for this appraisal, it is necessary to consider impacts over a longer timescale. It is important to note, therefore, that the aim here is not to seek to forecast the future, but rather, to compare one potential future scenario against

another; i.e. the accuracy of the baseline is arguably less important than a reasonable identification of the likely deviation from the baseline by the delivery options.

**6.1.1 Quantifying the Baseline**

Based on the findings from the research conducted as part of this study, an estimate of the current costs associated with seabed mapping activities undertaken in the UK for the stakeholders identified in Section 2.5.1 was made. This included:

1. An estimate of the economic cost associated with mapping activities, including surveying and gathering of raw data and processing and distribution of mapping outputs; and
2. The administrative burden of coordination among existing public/private sector programmes, undertaking procurements for surveying/ monitoring requirements, and storage, formatting and quality assurance of data.

The findings for each of these are summarised in Table 6-1 below, and explained further in the following sub-sections.

**Table 6-1: Summary of Baseline Cost Estimates**

Impact Category	Description	Total (Year 0)
<b>Economic</b>	Main Public Sector Programmes	£14.8m
	Other Noteworthy Public Sector Programmes	£4.1m
	Private Sector Activity	£101.4m
	<b>Total Seabed Mapping Activity</b>	<b>£120.3m</b>
<b>Administrative</b> (as part of the Economic Costs)	Coordination & Scoping, Procurement and Data Management Costs	<b>£10.2m</b>

Administrative costs percentage of Total Economic Costs = **8.5%**  
*\*In all cases, actual budget values were not available for each seabed mapping programme. See Section 6.1.1.1 for full details of the data used for this estimate.*

Source: Eunomia Research & Consulting Ltd.

It is reiterated here that the administrative burden associated with existing programmes is included within the baseline annual cost/ budget figures for each existing delivery option, as they are considered to be an economic impact and because limited information regarding both the budgets of each existing programme, as well as the

break-up of costs among economic and administrative activities was available. However, for the purposes of this assessment, administrative impacts were calculated separately from the economic impacts using Standard Cost Model (SCM) methodology<sup>76</sup> – it is therefore assumed that economic growth rates associated with the programme options do not include administrative impacts, allowing for the avoidance of double counting in the aggregation of the economic ‘outcome’ and the administrative outcome together.

### 6.1.1.1 Baseline Economic Costs

To date we are unaware of an attempt to quantify the overall size of the UK seabed mapping sector. Through the research outlined in Sections 3.0 and 4.0 a range of data on the cost of activities taking place has been gathered. This data and information has been aggregated in order to present an estimate of the total expenditure on seabed mapping activity in the UK – estimated to be £120 million per annum. Seabed mapping activities also directly support an estimated 1,400 FTEs in the sector.

Considering the public sector estimate of expenditure of £18.9m per annum, the seabed mapping activities can be broken down by the two types of programmes discussed in Section 3.1; these are the main programmes and noteworthy programmes.

For the four main programmes, the average (median) budget allocated for seabed mapping was £3.7m based on the economic data identified in the research. The data substantiating this figure is robust, therefore a relative high degree of confidence can be associated with the estimate of approximately £14.8m being spent on the four main programmes each year.

For the noteworthy programmes commissioned by the public sector, the seabed mapping activities are likely to be ad-hoc in nature. Thus it is harder to estimate the average expenditure for these types of programmes. Based on a review of historic activity, it is assumed that approximately 1.5 programmes are funded by the public sector each year – it is noted, however, that from time to time this might increase or decrease. The average (median) costs of the other noteworthy programmes are estimated to be smaller than that of the main programmes at £2.8 million per annum. Again this figure is based on a review of the historic expenditure. In total it is therefore estimated that approximately £4.1m is spend on noteworthy programmes each year.

Considering the estimate of private sector annual expenditure on seabed mapping activity, the sources of information are less robust than those for the public sector as much of the expenditure is not publically disclosed (due to commercial sensitivity). Based on the research completed in Section 3.2, it is understood that the private sector spends far more than the public sector on seabed mapping, supporting a range of maritime sectors.

---

<sup>76</sup> BRE (2005) Measuring Administrative Costs: UK Standard Cost Model Manual, Better Regulation Executive, September 2005, <http://www.berr.gov.uk/files/file44503.pdf>

It is estimated that approximately £101.4m is spent per annum by the private sector, based on industry supplied figures on the value of their surveying contracts and their evaluation of their market share. The main commissioners of the seabed mapping are as follows:

- Oil & Gas Sector - £32.9m;
- Offshore Renewable Sector – £31.4m;
- Telecommunications and Cables Sector £31.4m; and
- Inshore Surveys £5.7m.

It is understood that recent spent on seabed mapping activity from the Oil & Gas sector has been in excess of approximately £60m per annum. However, following the drop in oil prices, expenditure on seabed mapping activity has halved. Appendix A.3.0 provides further details associated with the assumptions underlying the baseline data provided above.

### Baseline Administrative Costs

Administrative costs to the key stakeholders identified were estimated separately from the total economic cost of existing seabed mapping programmes, using the SCM Methodology. The SCM methodology breaks down impacts into manageable components that can be measured, using the following formula:

$$\begin{aligned} \text{Cost/Benefit of Activity} &= \text{Price} \times \text{Quantity} \\ &= (\text{Wage Rate} \times \text{Time}) \times (\text{Population} \times \text{Frequency}) \end{aligned}$$

Assumptions surrounding each component input, and the sources of these assumptions are detailed in Appendix A.3.0. The outputs of the model were further sense-checked against information gathered in Tasks 1, 2 and 3, indicating that administrative costs of individual programmes ranged from 1% in fixed term, less coordinated programmes, to 10% in larger, continuous programmes, reflecting a final average proportion of administrative activities accounting for 8.5% of the estimated total costs of seabed mapping, as shown in Table 6-1.

#### 6.1.1.2 Baseline Economic Benefits

As identified in the Section 3.0, there are significant economic benefits associated with current seabed mapping efforts. To date, it is understood that no comprehensive assessment of the total benefits from all seabed mapping activity in the UK has taken place.

The efforts to appraise the economic impact of the programmes have instead typically been focussed on the relative merits of individual programmes. Examples include the Financial Benefits of Hydrographic Survey evaluation report published by Anatec Ltd on

behalf of the MCA<sup>77</sup>, as well as the Review of Access to Industry Marine Environmental Data report published by ABP Marine Environmental Research and Peter Barham Environmental on behalf of the Productive Seas Evidence Group.<sup>78</sup> A wide range of benefits have been identified in these studies and include (but not limited to) navigational benefits (quicker voyages, reduced insurance costs, less reliance on pilots, etc.), commercial fishing benefits (reduced net and equipment losses) and avoided environmental damage.

Almost all activity in the marine environment is supported by seabed mapping in one form or another, thus it is incredibly difficult to ascribe an economic value to its benefits. To place the value of the UK marine sector in context, the maritime sector (including marine manufacturing and engineering, shipping, maritime professional business services and ports) contributes over £11 billion a year to the UK economy.<sup>79</sup> In regards to the value of some of the major sectors engaged in seabed mapping already referenced in this report, offshore renewables are expected to make the largest contribution to meet the UK's commitment to providing 15% of all energy (i.e. electricity, heat and transport) from renewable sources by 2020. The UK economy could gain £6.7 billion per year and 35,000 direct jobs by 2020 from the development of offshore renewable energy resources, according to a report published by the ORE Catapult in March 2014.<sup>80</sup> A 2015 economic report by Oil and Gas UK states that the UK Continental Shelf continues to satisfy just over 50 per cent of the UK's oil and gas demand. Offshore oil and gas extraction, last year, was the sixth largest contributor to national gross value added among the 37 production, manufacturing and construction sectors in the UK economy. Production of oil and gas boosted the balance of payments by £25.2 billion in 2014 and the same report estimates that through direct, indirect and induced employment, the UK Continental Shelf supports over 375,000 jobs in the oil and gas sector.<sup>81</sup>

In the absence of an economic appraisal of all seabed mapping activity, some individual programmes have sought to quantify their impacts. The total benefit of hydrographic data within the CHP area was calculated to be £72.3m – indicating a cost to benefit ratio of approximately 1:10 and 1:13; highlighting significant benefits. Examining economic evidence from beyond the UK, studies by IHO Member States have suggested that the cost to benefit ratio is about 1:10 for major maritime nations. In a cost/benefit analysis

---

<sup>77</sup> Anatec Ltd, 'Financial Benefits of the Civil Hydrography Programme'.

<sup>78</sup> Productive Seas Evidence Group, ABP Marine Environmental Research Ltd, and Peter Barham Environmental Ltd, 'A Review of Access to Industry Marine Environmental Data'.

<sup>79</sup> Department for Transport, 'Maritime Growth Study: keeping the UK competitive in a global market; Moving Britain Ahead', September 2015.

<sup>80</sup> Offshore Renewable Energy Catapult, 'Generating Energy and Prosperity: Economic Impact Study of the Offshore Renewable Energy Industry in the UK', March 2014, <https://ore.catapult.org.uk/documents/10619/116053/pdf/15b55f52-5a1f-4e5a-aa32-ee0dba297bce>.

<sup>81</sup> Oil and Gas UK, 'Oil and Gas UK Economic Report 2015', accessed 18 March 2016, <http://oilandgasuk.co.uk/wp-content/uploads/2015/09/Oil-Gas-UK-Economic-Report-2015-low-res.pdf>.

for the Irish Government, performed by PwC in 2008, the cost of a high-intensity survey to complete the multibeam mapping of the Irish EEZ was put at €70 million with the economic benefits calculated as €440 million, indicating a cost to benefits ratio of 1:6. The key economic sectors expected to benefit from the programme were predicated to be the fishing, aggregates and aquaculture sectors. However, as noted in Section 3.4.2, this figure was appraised against the backdrop of no seabed mapping activity taking place and therefore it is unclear whether in reality private sector activity would have replaced public sector activity. Another caveat to using the INFOMAR estimates is the differing size and configuration of the UK maritime sector compared to that in Ireland.

### 6.1.2 Forecast of the Baseline Scenario

Following the establishment of the current costs of seabed mapping programmes for 2015/16 (Year 0), in order to establish the baseline scenario for comparison against each of the proposed programme option scenarios, it was necessary to estimate and project growth rates for each economic impact across the 10-year modelling period.

As outlined in Section 6.1.1.1, the baseline economic costs associated with seabed mapping activity is estimated to be £120.3 million in 2016/17, divided among public and private sector as £18.9 million and £101.4 million, respectively.

There appears to be considerable demand for additional seabed mapping in the coming decade, primarily driven by the need for increased mapping coverage, near-shore surveys and detailed geological and habitat maps of the UK marine area. For the private sector, seabed mapping is a critical component that helps develop the blue economy. Despite this need, the limited availability of funds for some of the existing programmes and the uncertainty around the continuation of some of the current programmes has informed an assumption that there would be no growth in real terms across public and private sector programmes going forward.

For the public sector, it is likely that reductions in central Government expenditure will occur. However, the need for seabed mapping activity will still exist and therefore it is estimated that the source of the money is likely to change with a reduction from central Government funding and an increase in research and scientific funding – especially from the European Union. This is a conservative assumption given that the budget released by the Treasury in March 2016 has committed to invest *“a further £20 million of funding for a second round of seismic surveys in 2016-17, as announced by the Prime Minister in January, to build on the success of the seismic programme in 2015 and encourage exploration in under-explored areas of the UKCS”*.<sup>82</sup>

---

82

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/508193/HMT\\_Budget\\_2016\\_Web\\_Accessible.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/508193/HMT_Budget_2016_Web_Accessible.pdf)



For the private sector, the need for seabed mapping is expected to continue in many of the sectors currently commissioning work. As noted in Section 6.1.1.1, the Oil & Gas sector expenditure on seabed mapping is already forecast to be half of the value previously spent in the most recent period, primarily due to lower oil prices. Based on the interviews with private sector organisations it is assumed that the level of expenditure will continue at current levels for the foreseeable future.

## 6.2 Cost and Benefits of the Options

In the following sub-sections, an assessment of the costs and benefits associated with each of the two national programme options is presented. In addition, a qualitative assessment of the distribution of these impacts across various stakeholder groups accompanies the quantitative assessment, where relevant.

Unquantified impacts are also identified, where they are expected to be significant, though these are not included in the quantitative modelling in order due to uncertainty in monetising their values.

All statements and figures quoted should be read in the light of the considerable uncertainty that surrounds predictions of economic impacts made over the 10-year modelling period. Furthermore, the indicators quantified in this assessment are limited in scope. While these are based on best estimates derived from secondary research and discussions with key stakeholders, it is impossible to predict with certainty the direction and scale of impact that each of the options may have. This is because while the model estimates impacts of a national seabed mapping programme in isolation, in reality the programme will be implemented alongside a range of co-dependent political and economic drivers arising from other programmes being run in tandem, particularly in the light of the interlinked impacts of programmes like MEDIN and the Government's Marine Plans.

Furthermore, the stakeholders identified in this study represent only those who are expected to experience the direct impacts of a national programme being implemented over the 10-year period. In reality, such a programme would affect the wider UK economy, and in some cases impact beyond the UK. While a full estimation of this multiplier effect is very difficult, it has been estimated that the marine and maritime sector (including marine manufacturing and engineering, shipping, maritime professional business services and ports) contributes over £11 billion a year to the UK economy.<sup>83</sup> A significant amount of this economic activity is dependent on the availability of, as well as access to, high quality, up-to-date marine data and maps for navigational routing, siting, resource monitoring and exploration, etc. This potential impact increases further when

---

<sup>83</sup> Department for Transport, 'Maritime Growth Study: keeping the UK competitive in a global market; Moving Britain Ahead', September 2015.

the activity of other significant sectors operating within the marine environment are considered, such as the offshore renewable energy sector, oil and gas, fishing, aquaculture, aggregates, marine planning, marine tourism etc. in 2015 the regional trade body Marine Southeast estimated the size of the UK’s Blue Economy, encompassing transport and logistics, energy resource, mineral resource, living resource, defence and security, maritime services and marine manufacturing to be worth approximately £51 billion in direct GVA.<sup>84</sup>

**6.2.1 Identification of Impacts**

A summary of the quantified impacts associated with the delivery of the options are shown in Table 6-2 and Table 6-3. It is forecast that the same impacts will occur for both of the options considered in this assessment. However, as described in later sections, the magnitude of the impacts for each of the options is likely to be different due to the ‘light’ and ‘full’ implementations.

**Table 6-2: Summary of Key Quantified Administrative Impacts**

Key Administrative Impacts	Sector Impacted
Costs associated with the coordination and scoping of seabed mapping activities for the national programme	Public Sector, though Private Sector may wish to also undertake additional effort to coordinate their activities on a voluntary basis (costs not calculated)
Procurement of additional seabed mapping services	Public Sector
Costs relating to the management and storage of additional data	Public Sector

**Table 6-3: Summary of Key Quantified Economic Impacts**

Key Economic Impacts	Sector Impacted
Savings and costs associated with reduced duplication of seabed mapping activity <b>(primary impact)</b>	Public Sector and Private Sector

---

<sup>84</sup> Based on an aggregation by Marine Southeast of: Oxford Economics analysis of ports, shipping & maritime service (2011), Oxford Economics update of above + marine equipment, ship/boat building, renewable energy & R&D (2012), Crown Estate analysis of all sectors including oil & gas (2005)

<b>Key Economic Impacts</b>	<b>Sector Impacted</b>
Additional benefits associated with increased quality survey data (derived impact)	Public Sector and Private Sector
Additional benefits associated with additional survey data (derived impact)	Public Sector and Private Sector

**Table 6-4: Summary of Key Quantified Economic Impacts**

<b>Key Economic Impacts</b>	<b>Sector Impacted</b>
Savings and costs associated with reduced duplication of seabed mapping activity	Public Sector and Private Sector
Undertaking new seabed mapping activity	Public Sector

### **6.2.2 Quantification of the Administrative Impacts**

Administrative impacts associated with the implementation of a national programme for seabed mapping in the UK are expected to be experienced by the public sector stakeholders through the main activities identified in Table 6-5.

**Table 6-5: Forecast Administrative Impacts**

Area	Impact	Type of Impact	Impact forecast for Option 1	Impact forecast for Option 2
<b>Coordination and scoping of seabed mapping activities</b>	Coordination activities associated with bringing together resources, as well as the additional effort associated with the development of guidelines, standards, templates etc. for those providing/ accessing the data produced as part of the programme	Cost	✓	✓
	Reviewing evidence and identification of areas for future mapping activity	Cost	✓	✓
	Determination and consultation on areas to be mapped	Cost	✓	✓
<b>Procurement</b>	Reduction in the number of procurements being required to be operated. Procurement requirements to become more complex as there is a need to integrate multiple needs.	Neutral	✓	✓
<b>Data Management</b>	Procurement of data storage for the additional data derived	Cost	✓	✓
	Management and quality assurance of additional data	Cost	✓	✓

Given the level of coordination associated with each of the national programme options one might also forecast that there would be some additional administrative savings associated with the delivery of the national programme. The national programme will require significant administrative effort to coordinate all of the various activities. It is considered unlikely that additional savings would occur initially. Such savings beyond the baseline might be possible in the future once a national programme has been established. For the purpose of this assessment such savings have not been forecast; therefore offering a conservative approach.

The administrative costs for each of the options were similarly calculated using the SCM Methodology. Several key assumptions were made in order to estimate these costs in the option scenarios, including:

- Average daily earnings for FTEs across public and private sectors of £105.60; with higher rates for senior officials/ management/ directors of £156.82, in line with the ONS Annual Survey of Hours and Earnings, 2015 Provisional Results; and
- A total of 42 organisations undertaking identified activities, including 25 involved in key existing public sector mapping programmes and an additional 17 estimated to be actively involved in seabed mapping activities across the four key private sectors identified (oil and gas, aggregates, renewables, and telecommunications).

Given these assumptions, the NPV of administrative costs across 10 years, associated with both programme options are highlighted in Table 6-6. Columns detailing option burdens represent the administrative costs calculated for each option in absolute terms, while columns detailing option impacts represent additional costs associated with implementing each option relative to the baseline.

**Table 6-6: Summary of Administrative Cost Impacts (10 Year NPV)**

Administrative Costs Activity	Option 1 (£ millions)		Option 2 (£ millions)	
	10 Year Total Cost (NPV)	10 Year Net Cost (NPV)	10 Year Total Cost (NPV)	10 Year Net Cost (NPV)
Coordination and Scoping	3.8	2.1	5.0	3.2
Procurement	9.5	0	9.5	0
Data Management	10.2	0.3	10.9	1.1
<b>Total</b>	<b>23.5</b>	<b>2.4</b>	<b>26.0</b>	<b>4.8</b>

It can be seen that the figures for total administrative impact under both programme option scenarios represent a higher outlay than that associated with the current or

baseline scenario, with an additional £2.4 million across ten years associated with the implementation of Option 1, and £4.8 million with Option 2.

Furthermore, a significant proportion of additional outlay in both options is attributed to coordination and scoping activities. These are expected to arise primarily from the undertaking of prioritisation and determination/ consultation process associated with the decision on areas to be mapped in each year of the programme's implementation. In this regard, costs under Option 2 are expected to be higher than those under Option 1, reflecting a greater integration of surveying activity.

In both cases, it is estimated that overall spending on procurement activities is not likely to be significantly impacted, with no overall impact for both options.

Finally, an additional cost associated with data management activities has also been estimated under both programme options. While in the case of Option 1, this amounts to an additional £300,000 expenditure over 10 years, associated primarily with formatting and quality assurance for existing data to be integrated into a set format and standard, under Option 2 this outlay is higher. This is because unlike Option 1, Option 2 represents an opportunity for identifying further duplication of existing efforts and thus the prospect of reinvesting the resources in to new seabed mapping activity. The additional costs required for the storage of this new data, as well as formatting and processing of this greater volume explain the higher costs under this option.

### 6.2.3 Economic Impacts

Alongside the administrative impacts, significant economic impacts are forecast due to the expectation that a national programme will reduce the overlap of surveying effort and by enabling better coordinated surveying to take place.

During the course of the interviews, no organisation could provide a clear identification of how much expenditure on surveying might be saved by the introduction of a national programme by avoided duplication. Therefore, in the absence of this evidence conservative estimates for each of the options are provided. These are based on an interpretation of the interviews and assessment of the introduction of other national programmes (identified in Section 3.4).

For the private sector, it is anticipated that there will be savings associated with avoided duplication of seabed effort. These will be derived from more open and transparent access to a greater quantity of public seabed mapping data. The extent of avoided duplication is expected to be half of those of the public sector. This is on the basis that private sector seabed mapping activity is often highly bespoke.

For the public sector improved coordination of survey activity will avoid some duplication. In addition to this benefit, it is also expected that a number of derived impacts also occur. These are:

- Additional survey data. For each of the options, the avoidance of duplication is expected to release resources to undertake additional surveying of new areas previously unmapped with MBES. This activity will generate new survey data – be that in new areas, and/or using different techniques. It is not however assumed

that all savings made by the private sector will be reinvested into further surveying work, as is the case with the public sector savings;

- Increased quality of survey data. The use of common standards is expected to raise the quality of data generated by the national programme. Thus it will be possible to use the data to develop new products and services; and
- Improved dissemination of survey data. Increasing the availability of survey data is expected to further aid the development of new products and services.

### **Option 1 Scenario: National Programme - Light**

In this scenario, it is assumed that relative to the baseline, 10% per annum of the public sector surveying effort is saved after the first year (i.e. starting in 2017/18) due to increased coordination and avoided duplication. For the private sector, it is forecast that 5% of the effort will be saved.

The public sector savings are assumed to be reinvested to undertake further seabed mapping activities in new areas which would not have otherwise taken place, delivering the derived benefits of additional data, better quality outputs and improved data dissemination. Partnerships for EU funding, as well as for other external funding streams for seabed mapping initiatives which complement the priorities identified by the programme and for which the UK would be eligible, will be actively sought to supplement the programme's baseline budget. The organisation or group of organisations coordinating the national seabed mapping programme will be developing and submitting funding applications, as appropriate.

Quantifying the economic impact of these derived impacts is extremely difficult. As outlined in Section 6.1.1.2, there is a dearth of evidence relating to the economic benefits of the entire seabed mapping effort in the UK and therefore it is difficult to ascribe a comprehensive forecast.

For this option, new public sector survey activity is likely to be prioritised in areas identified by a national mapping organisation in collaboration with other bodies as being of significant need i.e. areas identified as commercially, environmentally and scientifically important and where potential duplication of surveying could occur. Data derived from these areas are likely to yield significant economic benefits as are likely to have multiple uses. Accordingly, it is estimated that a benefit multiplier factor of 5:1 is associated with the savings. This estimate has been based on the analysis of the literature, particularly focussing on the cost benefit analysis carried out for the INFOMAR programme and have been adapted from the benefit to cost ratios of these studies in order to reflect the context of the potential programmes under analysis in this one, on the basis of information obtained from the interviews. The benefit is likely to fall on all users of the data (rather than those who commission seabed mapping activity). This is likely to comprise of organisations in both the public and private sectors.

The 10 year NPV of savings are forecast to be £106.8m, with £37.3m directly falling on the private sector commissioning seabed mapping activities compared to £13.9m for the public sector, as shown in Table 6-7.

**Table 6-7: Option 1 - Summary of Economic Impact (10 Year NPV)**

Sector	Primary Benefits	Re-invested Primary Benefits	Derived Benefits	Total Economic Impact
Private Sector	£37.3m	N/A	£69.5m	<b>£106.8m</b>
Public Sector	£13.9m	<b>-£13.9m</b>		

**Option 2 Scenario: National Programme - Full**

Under this option, it is assumed that 15% of public sector spending on seabed mapping is saved per annum after the first year (i.e. starting in 2017/18) due to avoided duplication of surveying effort. As is the case under Option 1, for the private sector it is forecast that 5% of the effort will be saved as there will be less opportunity.

These rates of saving due to avoided duplication are based on an understanding of the findings of the literature review regarding the current extent of duplicated survey effort, as corroborated by the interviews undertaken as part of this research. The public sector savings are greater than that reflected in Option 1 as this programme will have greater coordination of all seabed mapping activity.

Like Option 1, a key impact associated with this programme option is the delivery of greater amount of new data, with the potential to deliver wider derived benefits. The public sector savings are assumed to be reinvested to undertake further seabed mapping activities which would not have otherwise taken place, delivering the derived benefits of additional data, better quality outputs and improved data dissemination. However, unlike Option 1, this option does not prescribe that the new survey efforts is conducted in areas where the potential value to the mapping the area are broad (areas identified by a national mapping organisation in collaboration with other bodies as commercially, environmentally and scientifically important and where the risk of duplication is greatest). New areas will be mapped underpinned by evidence gathered or presented to a national mapping organisation that could yield narrower benefits for particular sectors or initiatives or for speculative or exploratory reasons. In some cases the data derived from the additional survey effort may not be widely utilised. Accordingly a lower benefit multiplier factor of 2:1 associated with the reinvestment in data acquisition is forecast. Like Option 1, it is forecast that the benefits fall on all users of the data (rather than those who commission seabed mapping activity). This is likely to comprise of organisations in both the public and private sectors. Furthermore, as with Option 1, partnerships for EU funding, as well as for other external funding streams, for all seabed mapping initiatives for which the UK would be eligible would be actively sought to supplement the programme’s baseline budget and the national mapping organisation in collaboration with other bodies will develop and submit applications.

The 10 year NPV of savings are forecast to be £79.0m, with £37.3m directly falling on the private sector commissioning seabed mapping activities, as shown in Table 6-8.



**Table 6-8: Option 2 - Summary of Economic Impact (10 Year NPV)**

Sector	Primary Benefits	Re-invested Primary Benefits	Derived Benefits	Total Economic Impact
Private Sector	£37.3m	N/A	£41.7m	<b>£79.0m</b>
Public Sector	£20.9m	<b>-£20.9m</b>		

#### 6.2.4 Summary of Quantified Impacts

For both of the options presented in this assessment it is forecast that there would be considerable benefits associated with the introduction of a national seabed mapping programme. Based on the assumptions outlined in previous sections, it is estimated that the 10 Year NPV for Option 1 is forecast to be £104.4m, compared to £74.2m for Option 2. These are summarised in Table 6-9 and Table 6-10.

**Table 6-9: Option 1 Total Costs and Benefits**

Option 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	10 Year NPV
	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	
<b>Administrative Costs</b>	-£0.60	-£0.60	-£0.07	-£0.33	-£0.07	-£0.33	-£0.07	-£0.33	-£0.07	-£0.33	<b>-£2.41</b>
<b>Primary Economic Benefits (Savings)</b>	£0.00	£6.96	£6.96	£6.96	£6.96	£6.96	£6.96	£6.96	£6.96	£6.96	<b>£51.17</b>
<b>Primary Economic Costs (Savings Reinvested)</b>	£0.00	-£1.89	-£1.89	-£1.89	-£1.89	-£1.89	-£1.89	-£1.89	-£1.89	-£1.89	<b>-£13.90</b>
<b>Derived Economic Benefits</b>	£0.00	£9.45	£9.45	£9.45	£9.45	£9.45	£9.45	£9.45	£9.45	£9.45	<b>£69.49</b>
<b>Total</b>	<b>-£0.60</b>	<b>£13.93</b>	<b>£14.46</b>	<b>£14.19</b>	<b>£14.45</b>	<b>£14.19</b>	<b>£14.46</b>	<b>£14.19</b>	<b>£14.46</b>	<b>£14.19</b>	<b>£104.36</b>

**Table 6-10: Option 2 Total Costs and Benefits**

Option 2	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	10 Year NPV
	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26	
<b>Administrative Costs</b>	-£1.02	-£1.02	-£0.24	-£0.64	-£0.25	-£0.65	-£0.26	-£0.66	-£0.27	-£0.67	<b>-£4.82</b>
<b>Primary Economic Benefits (Savings)</b>	£0.00	£7.91	£7.91	£7.91	£7.91	£7.91	£7.91	£7.91	£7.91	£7.91	<b>£58.12</b>
<b>Primary Economic Costs (Savings Reinvested)</b>	£0.00	-£2.84	-£2.84	-£2.84	-£2.84	-£2.84	-£2.84	-£2.84	-£2.84	-£2.84	<b>-£20.85</b>
<b>Derived Economic Benefits</b>	£0.00	£5.67	£5.67	£5.67	£5.67	£5.67	£5.67	£5.67	£5.67	£5.67	<b>£41.69</b>
<b>Total</b>	<b>-£1.02</b>	<b>£9.72</b>	<b>£10.51</b>	<b>£10.10</b>	<b>£10.49</b>	<b>£10.09</b>	<b>£10.48</b>	<b>£10.08</b>	<b>£10.47</b>	<b>£10.07</b>	<b>£74.15</b>

### 6.2.5 Sensitivity Analysis

Within each delivery option, two additional scenarios have been modelled to provide a low and high estimate of the likely costs and benefits so to provide a sensitivity analysis. The best case impact scenario (presented in earlier sections) may not always be exactly equidistant to the low and high estimate scenarios, as the low and high estimates aim to provide the most feasible range.

For each of the low and high scenarios it is assumed that the administrative costs are the same as those presented in the best estimates for Options 1 and 2 as these are not deemed likely to vary significantly.

The economic benefits derived from reducing the duplication of survey effort relative to the baseline is one key assumption that delivers economic benefits. The best estimate assumes private sector avoided duplication of 10% and 15%, in Options 1 and 2 respectively. For the private sector, it was assumed to be 5% in both options.

These rates are based on a best estimate of the likely duplication to be removed by the national programme. However, to date no comprehensive assessment of the likely duplication has taken place. Therefore the savings rate may be higher or lower.

For the low estimate scenario it might be reasonable to assume that very little removal of duplication by the seabed programme is achieved. Based on needing to balance the administrative costs associated with setting up and operating a national programme (i.e. a hurdle rate of 0%), the level of duplication need to be removed for each option would be 0.2% of public sector seabed mapping expenditure and 0.1% of private sector mapping expenditure for Option 1. For Option 2, 0.7% of public sector seabed mapping expenditure and 0.4% of private sector mapping expenditure would be required.

For the high-impact scenario, it might be assumed that a higher level of duplication of seabed mapping activity is removed by the introduction of a national programme. In this sensitivity analysis, it is assumed that 33% of public sector seabed expenditure can be saved, alongside 16.5% of private sector expenditure for Option 1. For Option 2, 45% of public sector seabed expenditure can be saved, alongside 16.5% of private sector expenditure. These saving rates are considered to be the maximum that could be feasibility achieved based on the information examined in this study.

Table 6-11 summarises the expected NPV estimates over 10 years for each of the options modelled under the low- and high-impact scenarios, in addition to the best estimate scenario, as discussed in the preceding sections.

**Table 6-11: 10 Year NPV Estimates - All Scenarios**

Option	Description	NPV Estimate (£million)		
		Low	Best Estimate	High
1	National Programme: Light	0.0	104.4	349.9

Option	Description	NPV Estimate (£million)		
		Low	Best Estimate	High
2	National Programme: Full	0.0	74.2	247.6

The following key comments are made in respect of the above:

- In the high-impact scenario, as in the best estimate scenario, Option 1 yields a higher NPV over the 10 years compared to Option 2; and
- In the low-impact scenario, the zero NPV under each Option is representative of a hurdle rate of 0% i.e. the rate at which the present value of the net costs of the programme are covered by the net benefits of the programme.

In addition to using the NPV analysis, it is useful to consider the programme options in terms of BCRs, or the marginal benefit accruing to each additional £1 of cost incurred in the programme. These BCRs are presented in Table 6-12 across the range of scenarios for each option.

**Table 6-12: BCRs - All Scenarios (10 Years)**

Scenario/ Estimate	Option 1	Option 2
<b>Low Estimate Scenario</b>		
Costs (Present Value (PV), £M)	2.7	5.9
Benefits (PV, £M)	2.7	5.9
Ratio	1:1	1:1
<b>Best Estimate Scenario</b>		
Costs (PV, £M)	16.3	25.7
Benefits (PV, £M)	120.7	99.8
Ratio	7.4:1	3.9:1
<b>High Estimate Scenario</b>		
Incremental Costs (PV, £M)	48.3	69.6
Incremental Benefits (PV, £M)	398.2	317.1
Ratio	8.3:1	4.6:1

The following key comments are made in respect of the above findings:

- In the low estimate scenario under both options, a BCR of 1:1 is representative of the hurdle rate of 0%, as discussed in the preceding sections. As the savings rates assumed in this scenario are unrealistically low, the sensitivity analysis concluded that developing a national programme is justified; and
- In all scenarios, Option 1 is the preferred option as compared to Option 2, due to lower costs in the low-impact scenario, and a higher ratio of benefits to costs in the medium- and high-impact scenarios.

## **6.2.6 Unquantified Impacts**

Alongside the quantified impacts considered in the preceding sections, there are a number of key impacts potentially arising from the introduction of a UK national seabed mapping programme, which either cannot be easily quantified, or that are associated with significant uncertainty and hence, have not been quantified.

The findings of the research undertaken as part of this scoping study suggest that these impacts are considerable and must be regarded in conjunction with the findings of the economic modelling. The key unquantified impacts have been described in qualitative terms in the following sub-sections. An estimate of the impacts in relation to the two options has not been made, though it is recognised that the magnitude of the impacts is likely to be greater for Option 2 than for Option 1.

### **6.2.6.1 UK Marine and Maritime Sector Growth and Competitiveness**

A national programme for seabed mapping could be beneficial for the UK public and private sectors and could contribute new products and services to the UK economy.

#### **Improved Dissemination of Raw Survey Data**

For both of the options considered in this assessment it is expected that there will be an improved dissemination of raw survey data available to be used by the public and private sectors.

This improved dissemination is likely to benefit a range of organisations, these might include:

- Organisations commissioning seabed mapping activities because they are unable to access existing data. In such instances organisations may already be aware that an area has been previously mapped, but just unable to access the related data; and
- Organisations and individuals undertaking research and analysis which is partially dependent on seabed mapping data. These organisations may be currently unable to identify seabed mapping data that is available.

#### **Reduced Barriers to Growth**

The provision of seabed mapping services and the associated data collected, particularly with regards to hydrographic surveys, has been widely described in the literature as having the qualities of a public good i.e. one that will not be provided at the optimal

level by market forces alone.<sup>85 86</sup> It remains unclear whether, or to what extent, such a market failure currently exists in the UK. Further, whether the issue arises as a result of information asymmetry among public and private players, due to high search costs for information coupled with constrained budgets which result in risky behaviour, or simply due to irrational behaviour by market players, has not been examined. In any case, theoretically at least, the development of a national seabed mapping programme has the ability to address such as market failure, and could accelerate 'Blue Growth',<sup>87</sup> the EU's long term strategy to support sustainable growth in the marine and maritime sectors in several ways. These include:

- 1. Fishing and shipping industries:** There has been no estimation, to date, of the current overall value that seabed mapping data provides to the fishing and commercial and recreational shipping industries in the UK, whether in monetary terms or otherwise. As such, there can be no estimation of the additional value that a national programme would provide. It is widely accepted, however, that reliable, accessible, up-to-date information is crucial to all these industries, in order to not only prevent undue losses due to groundings, accidents and loss of equipment and gear, but also to promote efficiency in the development of better shipping routes and the reduction of congestion in a handful of established 'safe' zones. For example, an earlier study for the MCA estimated that up to 38% of the studied benefits of the hydrographic surveys in the UK accrued to the commercial shipping sector alone.<sup>88</sup> A national programme that allows open access to high quality outputs reduces the risk of accidents, gear loss, and equipment damage for those relying on outdated information, in particular, to avoid the costs of obtaining the newest charts available. Given how costly it is to collect high quality data, a national programme that can deliver these benefits to the fishing and shipping industries can potentially lead to a reduction in costs and effort for these industries; and
- 2. Investment Risk:** Currently detailed knowledge is estimated to be available for only ~30% of the UK's seabed. This is seen as a barrier for investment to offshore development, particularly for the renewable energy, telecommunications, and oil and gas industries. Having access to detailed seabed mapping data is likely to reduce the investment risks for a range of private industries, who might need less investment in acquiring baseline data in order to comply with licensing requirements. Similarly, foreknowledge of the areas to be mapped which will be

---

<sup>85</sup> Anatec for the Maritime and Coastguard Agency, *Financial Benefits of the Civil Hydrography Programme*, Report for 23 June, 2010

<sup>86</sup> Department of Defence, Australia (1992) *An Economic Analysis of the Benefits of the RAN Hydrographic Programme*, July 1992

<sup>87</sup> European Commission, 'Maritime Affairs - Policy: Blue Growth'.

<sup>88</sup> Anatec for the Maritime and Coastguard Agency, *Financial Benefits of the Civil Hydrography Programme*, Report for 23 June, 2010

shared in advance with key stakeholders under a national programme, will further reduce uncertainty in strategic planning for industry and foster private and public sector partnerships. It will become easier to the different stakeholders to align their objectives and requirements for surveying, and thus collaborate to reduce survey costs and further avoid the unnecessary duplication of survey effort. For example, in the telecommunications industry, particularly with regards to the installation of cables, the ability to use accurate, high quality survey data to map a suitable route is directly related to the minimisation of faults and the reduced need for costly repairs.<sup>89</sup>

### Opportunity for Public-Private Partnerships

While some coordination already exists among the public and private sectors separately, there is scope to further expand coordination and communication between the two. Improved coordination could help deliver efficiencies in undertaking seabed mapping activities and reduce costs. Depending on the programme delivery mechanism, such partnerships can be encouraged at several stages:

1. **Programme Design:** partnerships at the consultation stage can help align objectives and requirements for surveying, thereby jointly determining what types of data are needed and what the areas for mapping should be. One survey will therefore have the potential to satisfy many data needs;
2. **Programme Development:** through partnerships there can be a combination of available resources (such as survey equipment and vessels) and knowledge (such as existing databases), thereby increasing efficiencies and decreasing costs. Note however that this precludes commercially or strategically sensitive resources; and
3. **Programme Delivery:** Through partnerships there can be a system of continued consultation, and thereby open access to the outputs and data resulting from the surveys. Improving access to data can yield benefits for marine planning, business investment, the marine environment and navigational safety.

The proposed financing facility for contributing to private sector survey costs on the condition they collect and share high quality data will provide an additional opportunity for forming strong partnerships between public and private sectors. Greater collaboration between the public and private sectors through the sharing of data outputs can help each sector gain insights and valuable knowledge of each other that will only grow over time and could foster closer working relationships.

### Competition and Employment

It can be argued that given the considerable, albeit fragmented, effort already being made to coordinate UK seabed mapping activities (see Section 3.0), the introduction of a

---

<sup>89</sup> Information obtained during interviews suggested that submarine cable repair costs from \$600,000 up to \$1 million per repair.

national seabed mapping programme risks the introduction of a short run monopoly effect on the market. This is likely to arise from requiring high quality data to be collected to a certain standard, which will inevitably result in currently deployed older technologies becoming obsolete, and investments to be made in newer equipment.

In the long run, however, a national programme would involve a considerable time lag in implementation, providing all operators a lead-in time to strategically adapt to its implementation. Furthermore, depending on the delivery mechanism for the programme, it need not involve a displacement of existing market shares from the wider industry to the public sector, but rather a reallocation of the same, through public procurements, for example.

In addition, it is expected that additional mapping by private stakeholders will continue to be necessary for high quality, specific types of data. Hence the programme would not constitute a monopoly on seabed mapping activity, but rather the necessary consolidation of several fragmented efforts. Finally, the national data infrastructure arising from accelerated seabed mapping activities is likely to have a significant economic value. These long term impacts are more than likely to outweigh any adverse competition effects the programme may have in the short term.

#### **6.2.6.2 Research and Innovation Impacts**

A national programme would potentially accelerate seabed mapping activities through increased and more efficiently allocated funding and could lead to the development of 'value added' data, products and new technologies. One example of such technologies is Autonomous Underwater Vehicles (AUVs) and submarine gliders (see case study: Autonomous Underwater Vehicles in Section 4.2 for more information). Maritime autonomous systems and their application to seabed mapping (in which the UK is already a leader in technology design and development) have the potential to generate a significant source of income for the UK in the future in the form of exports. As indicated by the case study in Section 4.2, the oil and gas industry (e.g. BP, Shell) has already taken a significant interest in these technologies due to their ability to generate efficiencies in time, cost and risk with regards to seabed mapping surveying. BP report that they have been actively using AUVs and other marine observing technologies (e.g. ROVs, side-scan sonar, multi-beam, cameras, etc.) for some time to execute geo-hazard surveys, light inspection work, and broader environmental surveys across several operating regions.

Such systems can be put in harm's way with little or no associated risk, are already becoming more affordable to use and could very shortly become suitable for continuous autonomous monitoring of particular areas with the potential of generating vast amounts of data with little effort. At a time where oil prices are dropping and budgets are diminishing, particularly for the oil and gas and renewables sectors, autonomous maritime systems and maritime robotics in general, can help reduce costs and generate an additional source of income through exports.

There are some challenges for AUVs to overcome before the technology is employed more widely. The initial research and development investment to prove the technology may be marketable and can be widely used is one example. Another challenge relates to



the interpretation of the data captured, where the sheer quantity of data collected by AUVs can make it difficult and costly to process and interpret. It is understood that software is being developed to assist in this respect.

These technologies can streamline the data collection process and make it more efficient and less costly for a range of industries. There is an increasing pressure within some maritime sectors to reduce expenditure through innovation, thus a seabed mapping programme could provide an important platform to demonstrate the use of such marketable and exportable technologies, run competitions and generate opportunities for export and productivity growth in the future. A national programme could help attract further innovation funding in this field aid in cementing the UK's position as a leader in marine robotics and help secure European and other external funds to supplement a baseline budget for a national programme (see Section 7.1.2).

### 6.2.6.3 Environmental Impacts

In addition to the impacts discussed so far, the environmental impacts that could arise from a national seabed mapping programme are potentially significant, albeit the hardest to quantify. This is in part due to the difficulty in disaggregating benefits arising from individual programmes with similar impacts, such as those relating to achieving the obligations within MSFD and the Water Framework Directive (WFD).

#### Protection of Marine Ecology

Being an island country, sustainable growth in the UK is dependent on the health of its marine environment, though this often results in conflicts of interest between commercial sectors, interest groups and policy makers. This can be evidenced, for example, in the current controversial consultation on scallop dredging in the European Special Area of Conservation; Cardigan Bay.<sup>90</sup> In early 2015 the government designated 23 new MCZs in order to protect nationally important marine wildlife, a range of habitats, as well as specific geology and geomorphology, effectively declaring 20% of English waters as Marine Protected Areas. This figure represents less than half the originally proposed areas for protection, and excludes zones such as South Celtic Deep – a site that supports the short-beaked common dolphin.<sup>91</sup>

A significant part of this somewhat fragmented approach to marine protection to date can be attributed to European 'ecological mapping'. Having been undertaken at different spatial and temporal resolutions, often on a project basis, it results in an incomplete and uneven coverage.<sup>92</sup> However, accurate and complete information on the location and

---

<sup>90</sup> Welsh Government (2015), *Scallop Fishing in Cardigan Bay – New Fishing Measures*, 2015, <http://gov.wales/docs/drah/consultation/151126-proposed-new-management-measures-for-the-scallop-fishery-in-cardigan-bay-consultation-document-en.pdf>

<sup>91</sup> <http://www.theguardian.com/environment/2016/jan/17/englands-23-new-marine-conservation-zones-branded-useless-by-expert>

<sup>92</sup> Olsen EM, Johnson D, Weaver P, Goñi R, Ribeiro MC, Rabaut M, Macpherson E, Pelletier D, Fonseca L,

extent of habitat types in the UK's marine environment is becoming vital to resolving this conflict and can contribute to the sound management, development and protection of existing, and new MPAs as well as help identify best practice and the least environmentally disruptive areas for commercial activities. The data derived from a national seabed mapping programme and the resulting monitoring efforts can contribute to conservation efforts and to establishing an ecologically coherent network of marine protected areas.

### Prevention of Environmental Hazards

While the benefits of up-to-date, high quality maps on navigational safety have been discussed in the context of seabed mapping, an important aspect of this argument is the prevention of environmental damage arising from accidents. This can occur at several levels, from the loss of nets and gear from fishing boats, to the management of marine litter and to avoiding a major oil spill due to uncharted features. The value of the latter in particular has been widely estimated using CATS (Cost of Averting a Tonne of Oil spilled) values, with the value to the UK's commercial shipping industry from prevented oil spills due to the Civil Hydrography Programme being estimated at £9.76m per year.<sup>93</sup>

---

Katsanevakis S, Zaharia T (2013), Achieving Ecologically Coherent MPA Networks in Europe: Science Needs and Priorities. *Marine Board Position Paper 18*. Larkin, KE and McDonough N (Eds.). European Marine Board, Ostend, Belgium, 2013.

<sup>93</sup> Anatec for the Maritime and Coastguard Agency, *Financial Benefits of the Civil Hydrography Programme*, Report for 23 June, 2010

## 7.0 Conclusions and Recommendations

---

The research has identified that there is a clear need and appetite for a national seabed mapping programme. Most importantly a national programme could lead to increased data sharing and reduce the unnecessary duplication and improved coordination of survey activities commissioned by both the public and private sectors, which was considered to be one of the key advantages of a national approach to seabed mapping.

The research has shown that a national programme can be effective and successful. Both MAREANO (Norway) and INFOMAR (Ireland) are considered to be examples of successful national programmes that have yielded invaluable information to their Governments and a range of maritime sectors; helping improve navigational safety, accelerate offshore development and contribute to national economies. Furthermore, both programmes have provided wider benefits to society, and have contributed to the public awareness of marine issues and to legislative reforms.

Whilst there are already significant benefits to existing seabed mapping activity, new and better quality data can deliver numerous additional benefits to the UK maritime economy. The increased availability of high quality public data could de-risk private investment, reducing the cost of borrowing and opening up new areas of financing. It could contribute to and accelerate Blue Growth,<sup>94</sup> the EU's long term strategy to support sustainable growth in the marine and maritime sectors. As identified in other national seabed mapping programmes, a UK seabed mapping programme could also be used to leverage in European funding and provide a testbed for research and innovation, attracting further investment. A national seabed mapping programme can showcase marketable technologies such as AUVs, which are a product of research and innovation activities in the marine robotics field, thereby cementing the UK's position as a leader in this field and potentially generating growth through exports. Growth in this area is particularly important to the UK marine economy.

Significant societal and environmental impacts could also be derived from a national seabed mapping programme. Improved coordination and access of seabed mapping data could be used to underpin flood and coastal erosion mapping and contribute to existing efforts undertaken by the Government in these areas. It could be used to support the implementation of the Marine and Coastal Act 2009 and the EU Habitats Directive, along with a range of other marine national and European legislation.

As outlined in Section 5.0, two delivery options for a UK national seabed mapping programme have been outlined and modelled from a cost-benefit perspective, alongside

---

<sup>94</sup> European Commission (2014) *Maritime Affairs - Policy: Blue Growth*, accessed 18 June 2015, [http://ec.europa.eu/maritimeaffairs/policy/blue\\_growth/](http://ec.europa.eu/maritimeaffairs/policy/blue_growth/)

the baseline scenario (which is the scenario in which the status quo or 'business as usual' is maintained). In summary, these are:

- 1. Option 1: National Programme – Light:** A national programme coordinated by a single organisation or a partnership of organisations (or even a newly created body with combined staff from various interested parties), and the survey activities undertaken are focused on existing and new areas identified as being of significant need. The definition of significant need is likely to be based on areas which are identified by a national mapping organisation in collaboration with other bodies as commercially, environmentally and scientifically important and which are at risk of having duplicated surveying efforts conducted in them. It is assumed that these areas would be in addition to those which the UK has an obligation to map under the International Convention for the Safety of Life at Sea (SOLAS) for the purposes of navigational safety and other such obligations.
- 2. Option 2: National Programme – Full:** A national programme where the survey activities undertaken are focused on all UK marine areas, not just those areas identified as being of significant need for commercial, environmental and scientific reasons and where the programme is needed to improve the coordination of activity.

The research undertaken as part of this scoping study suggests that Option 1 (i.e. a national programme focusing on existing and new priority areas only) would be the preferred approach, yielding a total economic benefit over 10 years of £104.4m (NPV). This compares to a slightly smaller total economic benefit over 10 years of £74.2m (NPV) for Option 2.

In both options, the benefits are forecast to fall on both the private and public sectors. Private sector organisations commissioning seabed mapping activity, which are concentrated in the Oil & Gas, Offshore Renewables and Telecommunications and Cables sectors, are forecast to benefit from avoided duplication. Users of seabed mapping data in both the public and private sector will also benefit from the increased quantity of higher quality data and improved sharing and access to this data.

Option 1 would essentially entail a transition from the way activities are currently undertaken in the seabed mapping sector towards a more coordinated programme, where decision making will be centrally made, yet the focus of the activity will be focussed on new and existing areas which will provide most value and return on investment (i.e. where the potential for the greatest duplication might occur and areas identified as commercially, environmentally or scientifically important). These areas may have already been identified as priorities for surveying, or may be identified as such in the future. Through improved coordination and communication amongst stakeholders, it will become easier to align objectives and requirements across various actors in the planning stages of surveys. This will help form strong partnerships between the public and private sector to work collaboratively to reduce survey costs, identify areas of priority for mapping and avoid the unnecessary duplication of survey activity (primary

impacts). Furthermore, this option will require that all survey activities abide by specific standards which will improve the quality of data being collected and maximise re-use. New and better quality data can lead to reduced navigational and investment risks, reduced loss of equipment and gear, environmental and innovation benefits, etc. (derived impacts). The model is based on the key assumption that any tangible public sector savings achieved by the programme in respect of primary impacts are reinvested into the programme in order to deliver the derived impacts. Although this assumption may not always be strictly followed in practice, it was a necessary inference to make in order for the model to be able to deliver any kind of savings. This assumption has not been made for private sector savings due to the bespoke nature of their surveying work. Instead, the assumption is that the private sector will realise direct savings to the cost of their business activities.

For both options there would be an expectation that as benefits are realised and an evidence base for increased mapping activity is built up, the scope of the programme would expand with the end goal being to map the entire UK Continental Shelf. This progressive model mirrors that seen in the formation of other successful national seabed mapping programmes such as INFOMAR and MAREANO. The additional data being collected would also facilitate development of industries such as aquaculture, aggregates, fisheries, cables/pipelines, port approaches and offshore renewables, as evidenced by INFOMAR.

It is acknowledged that there will always be a need for additional surveying to take place, particularly from the private sector, when specific data will need to be gathered in a specified timeline that the national programme might not necessarily align itself with. It is proposed that in order to improve efficiency between private sector organisations commissioning survey work and the national programme, a financing facility could be setup whereby the national programme would contribute to some of the private sector costs on condition that the data collected is relevant to the national programme, it meets a defined standard and can be made openly accessible.

Another potential condition of claiming finance could be that private sector organisations must share information about any upcoming survey plans. Open communication and transparency can improve coordination between the private sector and the national programme, increasing access to data for all stakeholders and potentially reducing duplication of effort even further. The level at which organisations can claim finance and the period of time during which such claims can be made by the surveyor will need to be determined if such a fund is setup, to ensure that the surveyors have an incentive to claim finance (i.e. that the amount of money being reclaimed does reduce the cost the surveyor would have incurred to undertake more survey work) and that the data being shared by the private sector is still relatively recent and thereby relevant for wider use.

The following sections outline further details on Option 1, including the scope of such a national programme, best practice for programme and data management and financing options, as well as a discussion of the associated benefits and risks of this approach.

## 7.1 Development of the National Programme

### 7.1.1 Programme Management

The findings from the scoping study suggest that a national programme would ideally be managed by a partnership of public sector organisations or even by a newly created body with combined staff from various interested parties. This will ensure that it will be able to maximise its potential of acquiring high quality data that can be widely re-used to meet various different needs. Strong public and private sector partnerships and leadership on both ends will be essential for progressing and driving forward a national seabed mapping programme and stakeholders should be regularly involved in the decision making around the selection of priority areas for surveying and in determining how to allocate the funding, amongst other issues.

A national programme would need to be an example of best practice for the seabed mapping sector. All data collected, regardless of focus (i.e. hydrographic, environmental, geological, biological, etc.) should conform to international standards such as the IHO S44 Order 1a for hydrographic data, to guarantee that it will be of high quality and ensure that it can be widely re-used. For example, the MCA's survey specification could be used as an example of how surveys should be undertaken under the national programme.

Furthermore, the programme's procurement and contract methodology should maximise efficiencies and be treated as an asset of the programme, similar to the CHP currently.

One of the biggest challenges under the national programme light option is determining a decision-making framework for how to decide which areas will be mapped and the risk that this is skewed towards one type of mapping over another. This is discussed further in Section 7.3.

### 7.1.2 Financing Options

The primary and secondary research conducted during this scoping study suggests that most well-funded and established seabed mapping projects have been publically funded on a rolling basis. Similarly, the majority of other national seabed mapping programmes which have been successful in delivering against their objectives have been financed through their corresponding governments; this applies to INFOMAR (Ireland) and MAREANO (Norway). The Pacific Regional Navigation Initiative in New Zealand has been funded through state aid as well as in-kind contributions.

Some seabed mapping programmes also supplement their initial government funding with value added projects, such as the development of decision support tools, international marine survey and consultancy contracts, partnerships with universities and funded research projects. This could also be beneficial to a UK national programme.

INFOMAR for example, has made extensive use of EU-funded initiatives and projects such as Seventh Framework Programme (FP7) during 2007-2013 (now replaced by Horizon 2020) and INTERREG IV-B (which has also been used successfully by the CHP).

Between 2009 and 2012 INFOMAR has received over €1.75 million in funding by partnering with academic institutions on research projects that have existing funding.<sup>95</sup> A breakdown of proposed funding sources for INFOMAR when it was being established can be seen in Table 7-1.

**Table 7-1: INFOMAR’s Programme and Funding Framework**

Programme 1 Data Acquisition, Data Management & Interpretation	Programme 2 Data Integration & Exchange	Programme 3 Value Added Exploitation Programme
<p><u>Measure 1:</u> Multi-Annual Acquisition Programme</p> <p><u>Measure 2:</u> Data Management &amp; Interpretation Programme</p> <p><u>Measure 3:</u> Applied Research</p>	<p><u>Measure 1:</u> Data Integration.</p> <p><u>Measure 2:</u> Data Exchange</p>	<p><u>Measure 1:</u> Development of Decision Support Tools &amp; Solutions</p> <p><u>Measure 2:</u> Commercial Opportunities in the International Survey Market</p> <p><u>Measure 3:</u> Value Added Research</p>
<p><u>Implementation Mechanism:</u></p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; background-color: #90EE90; padding: 5px; margin: 5px;">INFOMAR</div> <div style="border: 1px solid black; background-color: #FFDAB9; padding: 5px; margin: 5px;">Private Sector</div> </div> <div style="border: 1px solid black; background-color: #FFFF00; padding: 5px; margin: 5px; text-align: center;">National Marine Research &amp; Innovation Strategy</div> <div style="border: 1px solid black; background-color: #ADD8E6; padding: 5px; margin: 5px; text-align: center;">Other NDP Research Budgets 2006-2013</div> <div style="border: 1px solid black; background-color: #ADD8E6; padding: 5px; margin: 5px; text-align: center;">Core Agency Budgets</div> <div style="border: 1px solid black; background-color: #FFDAB9; padding: 5px; margin: 5px; text-align: center;">EU Programmes</div>		

Source: INFOMAR (2007)<sup>96</sup>

Some of the current European programmes that could be considered for financing a UK national programme<sup>97</sup> in addition to a baseline budget, are summarised below:

- INTERREG V covers the same areas as previous INTERREG programmes (i.e. cross-border cooperation, transnational cooperation and interregional cooperation) and has a total funding allocation of €10.1 billion for the period 2014-2020. To be eligible for this funding an entity must be from an EU Member State, Norway or Switzerland. INTERREG will co-finance up to 85% of project activities that carried out in partnership with other policy organisations based in different European countries. Funds must be spent within three years of receipt. This funding round,

<sup>95</sup> Tommy Furey, INFOMAR Co-project Manager, ‘INFOMAR EU Projects and Added Value’, 2010.

<sup>96</sup> INFOMAR, ‘INFOMAR, A Successor to the Irish National Seabed Survey, Proposal and Strategy’, March 2007.

<sup>97</sup> <https://www.gov.uk/guidance/european-territorial-cooperation-programmes>

the cross border cooperation programme will be focusing strongly on Scotland and Northern Ireland through INTERREG VA, which will bring €240 million of funding for cross border activities in West Scotland, Northern Ireland and the border counties of Ireland.<sup>98</sup> Some relevant funding topics include<sup>99</sup>;

- €11 million total to manage marine protected areas and species. These outputs can be achieved via seabed mapping; and
- €11 million total for the recovery of protected habitats and priority species. The outputs include mapping of protected habitats and sites of cross border relevance.
- Other UK regions are covered in the INTERREG VA France (Channel) England Programme. This programme runs from 2014-2020 and includes the coastal area from Cornwall to Norfolk and from Finistrere to Nord Pas de Calais in France. The ERDF co-financing rate has been set at 69% on a programme level. For the most recent call, submissions had an average budget of €4.6 million. This programme has focus areas in developing the 'green' and 'blue' economies. The programme will prioritise projects aiming to span the entire innovation process, including universities, research institutes, the public sector, companies, the third sector and social enterprises. Projects should have at least one English and one French partner<sup>100</sup>.
- Another INNTEREG VA programme is the 2 Seas programme, which also runs from 2014 to 2020. €241 million of ERDF funding has been allocated to this programme, and will cover 60% of a project's costs. Eligible countries include the UK, Netherlands, France and Belgium, however only certain coastal regions are included in this scheme, as seen in Figure 7-1. Any type of organisation can receive funding, to include public bodies, public equivalent bodies and private bodies. As the main goal is to 'overcome' the maritime border, each project should have at least one English partner.<sup>101</sup>

---

<sup>98</sup> Interreg, 'Citizens Summary: INTERREG VA Programme (2014-2020)', n.d.

<sup>99</sup> Ibid.

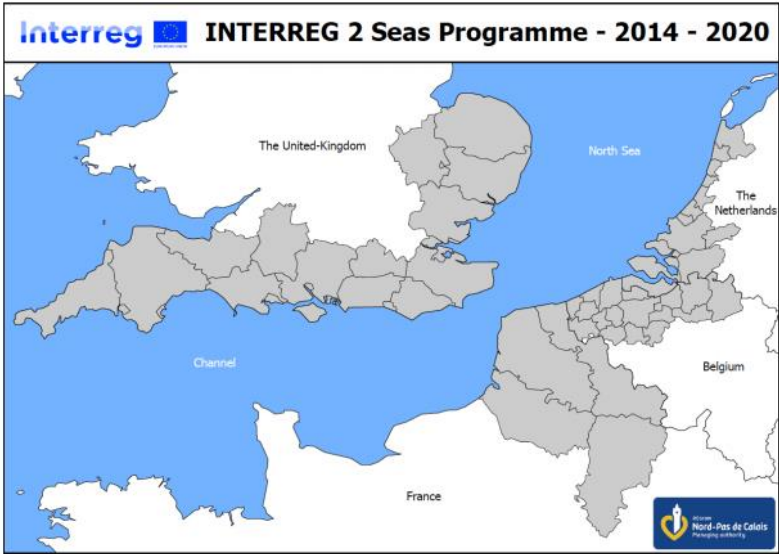
<sup>100</sup> Interreg France (Channel) England," n.d., <https://interreg5a-fce.eu/>.

<sup>101</sup> Interreg 2 Seas, 'Interreg 2 Seas Key Info', n.d.



**Figure 7-1: Areas Eligible for Funding under INTERREG 2 Seas Programme**

*Eligible area in grey*



Source: INTERREG 2 Seas Mers Zeeën, Cooperation Programme under the European Territorial Cooperation Goal

- Interreg Europe, the follow on from INTERREG IVC, has a budget of €359 million financed by the ERDF for the period 2014-2020. Interreg Europe assists public authorities, managing authorities/intermediate bodies, agencies, research institutes and thematic and non-profit organisations. Countries within the EU-28, as well as Switzerland and Norway are eligible for funding. For interregional cooperation projects, programme typically should last for 3-5 years and depending on size, can receive up to €1-2 million each (to be topped up with at least 15% match funding).
- Horizon 2020 (H2020) has replaced FP7 and will run from 2014 until 2020, with a total budget of up to €80 billion. The aim of H2020 is to ensure Europe produces world-class science, to remove barriers to innovation and to make it easier for the public and private sectors to work together in delivering innovation. H2020 has calls specific to marine and maritime research through its Societal Challenge work programme. Eligibility criteria for H2020 can be found in Table 7-2. For research and innovation streams the funding rate is 100%, other areas require 30% match funding unless the application is from a non-profit organisation, in which case they can receive the full 100% funding. For H2020, there are no formal project time limits but projects are generally completed within 2-5 years. There are no guidelines on funding limits.

**Table 7-2: Eligibility Criteria for Horizon 2020**

Instrument	Eligibility conditions for participation
<b>Research &amp; Innovation</b>	At least three legal entities. Each of the three must be established in a different EU Member State or Horizon 2020 associated country. All three

<b>Instrument</b>	<b>Eligibility conditions for participation</b>
<b>Actions</b>	legal entities must be independent of each other.
<b>Innovation Actions</b>	At least three legal entities. Each of the three must be established in a different EU Member State or Horizon 2020 associated country. All three legal entities must be independent of each other.
<b>Coordination &amp; Support actions</b>	At least one legal entity established in an EU Member State or Horizon 2020 associated country.
<b>SME Instrument</b>	At least one Small or Medium Sized Enterprise (SMEs). Only applications from for-profit SMEs established in EU Member States or Horizon 2020 associated countries.

Source: Horizon2020 Work Programme 2016-17 General Annexes.

- In November 2015, a €185.5 million fund, the Atlantic Area Transnational Cooperation Programme for 2014-2020, was also announced. This has a contribution of €140 million from the ERDF and is consistent with the EU sea basin strategy for the Atlantic Ocean. The Action Plan encourages Member States to work together in areas where they were previously working individually. The first call for projects is expected to be launched in the first half of 2016.<sup>102</sup> The funding covers the following priority areas and requires 25 % match funding;
  - Stimulating innovation and competitiveness;
  - Fostering resource efficiency;
  - Strengthening the territory's resilience to risks of natural, climate and human origin; and
  - Enhancing biodiversity and the natural cultural assets.

The Atlantic Area Programme will cover all Atlantic coastal regions in the UK, Ireland, France, Portugal and Spain as in Figure 7-2.

---

<sup>102</sup> Atlantic Area Transnational Programme, "European Commission Has Adopted the Atlantic Area Programme," November 2015. <http://www.coop-atlantico.com/>.

**Figure 7-2: Atlantic Area Transnational Cooperation Programme Eligible Regions**



Source: Atlantic Area Transnational Programme Eligible Regions, <http://www.coop-atlantico.com/atlantic-area-2020/eligible-area>

- Another potential funding model could follow the approach taken by the UKSeaMap 2010 project, which was a UK seabed habitat mapping project funded through multiple channels. The project used funding remaining from its predecessor, the UKSeaMap 2006, as well as sourced funding from a range of partners such as the JNCC, Defra, Scottish Government, DECC, The Crown Estate, Natural Resources Wales, NE, World Wide Fund for Nature (WWF)-UK, and the Royal Society for the Protection of Birds (RSPB). The project also received European Regional Development Funding (ERDF) through the INTERREG III B Community Initiative, as part of the Development of a Framework for Mapping European Seabed Habitats project (MESH).

It seems most feasible therefore that a UK national programme would receive predominantly public funding, with industry potentially funding specific projects in areas with vested interests. For example industry has previously financed the Marine Aggregates Regional Environmental Assessments and Oil & Gas has financed site surveys for potential drill sites. Like the INFOMAR and UKSeaMap projects, the UK's national programme would be eligible to apply to EU funding to supplement its budget. Examples of such funding pots are Horizon 2020 and the European Regional Development Fund, as

well as INTERREG, as summarised in this section. Table 7-3 provides an overview of funding arrangements for existing successful seabed mapping programmes that could be further considered.

**Table 7-3: Funding Frameworks for Existing Seabed Mapping Programmes**

Programme	Funding Source	Region	Details
<b>INFOMAR</b>	Irish Government	Ireland	<p>Funding of €4 million per annum was allocated to the INFOMAR programme for the period 2006-2008. It is funded through the Department of Communications, Energy and Natural Resources in Ireland, as part of the National Development plan 2007-2013.</p> <p>Funding has been extended to 2018 with a greater emphasis on the Value Added Programme.<sup>103</sup></p> <p>Value added programme includes PhDs, research partnerships and EU funding, as per below:<sup>104</sup></p> <ul style="list-style-type: none"> <li>• 2009-12: DG Marine EU Marine Observation data network - €4.5m</li> <li>• 2009-13: FP7 - €5.9m</li> <li>• 2010-12: INTERREG IVB - €2.5m</li> <li>• 2010 - ? : INTERREG IVB - €3.5m</li> </ul>
<b>MAREANO</b>	Ministry of Trade, Industry and Fisheries Ministry of Climate and Environment	Norway	<p>Financial Contributions via the national budget:<sup>105</sup></p> <ul style="list-style-type: none"> <li>• 2014: Million (Mill.) Norwegian Krone (NOK) 91.7</li> <li>• 2013: Mill. NOK 90.5</li> <li>• 2012: Mill. NOK 88.4</li> <li>• 2011: Mill. NOK 92,4</li> <li>• 2010: Mill. NOK 51.5</li> <li>• 2009: Mill. NOK 51.5</li> <li>• 2008: Mill. NOK 32.6</li> <li>• 2007: Mill. NOK 32.6</li> <li>• 2006: Mill. NOK 23.6</li> </ul> <p>About 40% of the funding allocated to MAREANO has been used to finance bathymetric mapping.<sup>106</sup></p>
<b>Pacific Regional Navigation Initiative</b>	NZAid UKHO Land Information	Pacific Island Countries	<p>Vanuatu Case Study:</p> <p>NZAid: NZ\$535,000 for Hydrographic survey</p> <p>UKHO, LINZ, GOV: NZ\$ 100,000 in kind for Hydrographic survey</p>

<sup>103</sup> INFOMAR, 'INFOMAR | Press Releases - GEOSCIENCE 2015 Conference, Underpinning Ireland Tourism, Maps & Apps by Geological Survey of Ireland', November 2015, <http://www.infomar.ie/press/>.

<sup>104</sup> Tommy Furey, INFOMAR Co-project Manager, 'INFOMAR EU Projects and Added Value'.

<sup>105</sup> 'MAREANO - Collecting Marine Knowledge'.

<sup>106</sup> 'Mareano - Bathymetric Mapping', accessed 27 November 2015, [http://mareano.no/en/topics/bathymetric\\_mapping](http://mareano.no/en/topics/bathymetric_mapping).

Programme	Funding Source	Region	Details
	New Zealand New Zealand Government		Pacific Regional Navigation Initiative: US\$4.4m five-year initiative and other in kind contributions to be determined. <sup>107</sup>
<b>UKSeaMap 2010</b>	JNCC, Defra, Scottish Government, Department for Energy and Climate Change, The Crown Estate, Natural Resources Wales, Natural England, WWF-UK, the RSPB INTERREG III B	UK	UKSeaMap 2010 is funded through funds which were outstanding after UKSeaMap 2006. UKSeaMap 2006 funding partners were the JNCC, Defra, Scottish Government, Department for Energy and Climate Change, The Crown Estate, Natural Resources Wales, Natural England, WWF-UK, and the Royal Society for the Protection of Birds. The project has also received European Regional Development Funding through the INTERREG III B Community Initiative, as part of the Development of a Framework for Mapping European Seabed Habitats project (MESH).

### 7.1.3 Data Management

The issue of data management came up repeatedly during the course of this scoping study, identified as the most prominent limitation of the current way seabed mapping activities are undertaken. This is as much from the aspect of sharing data and making it publically available once surveys have been completed, as well as from improving communication among stakeholders from the offset which can improve coordination and collaborations on survey work, and potentially prevent the duplication of survey work.

It is critical, therefore, that a national programme coordinates (and possibly consolidates) existing data libraries such as MEDIN, The Crown Estate's MDE and even private sector databases such as the Oil & Gas industry's UKBenthos database, as well as programmes such as MAREMAP.

A national programme could consider using existing data libraries such as MEDIN to host the data it will collect by utilising existing DACs and funding the creation of new ones.

Any data collected under a national programme assuming it will be funded predominantly by the Government, will be bound by the MoU and should be made publically available via an Open Government Licence, free of charge. However, value added products derived from the data (e.g. nautical charts) may be developed and provided for a charge which would open up an additional revenue stream.

---

<sup>107</sup> 'Pacific Regional Navigation Initiative. 2014 Third International Conference on Small Island Developing States', accessed 27 November 2015, <http://www.sids2014.org/index.php?page=view&type=1006&nr=2699&menu=1507>.

## 7.2 Opportunities and Benefits

The main advantages presented by Option 1 are:

- Increase in the availability of high quality, standardised, complete data for existing and new areas of strategic interest, which will be made available to all stakeholders;
- Acceleration of activities (e.g. planning, licensing) and de-risking of potential investment due to the existence of better quality baseline data;
- Incentives for further integration of activities and alignment of objectives among sectors and existing stakeholders during the procurement of services and technology for surveying and monitoring;
- Further improved coordination and partnerships among stakeholders; and
- A lower capital and operational cost outlay than that required by Option 2.

Currently there are many stakeholders involved in undertaking seabed mapping surveys requiring extensive and time consuming coordination and communication to align their objectives and requirements for surveying. This can result in the unnecessary duplication of activity and the inefficient use of resources.

The national programme will coordinate seabed mapping activities, potentially reducing the planning and project lead times, improving communications and increasing the number of partnerships, where a single survey can be used to collect different types of data to high specifications.

In addition, the national programme will also provide a single point of contact for all public and private sector organisations to communicate through, which could improve communication between stakeholders and lead to an increase in collaborative working.

Furthermore, the national programme will aim to generate higher quality data across all seabed mapping activity, maximising the potential use of that data and helping de-risk investment and accelerate development. All survey activities under the national programme would need to comply with specific national and/or international standards (e.g. IHO S44 Order 1a for hydrographic data).

Currently due to lack of dedicated funding, there is no central depository for the data being collected, and initiatives such as MEDIN and The Crown Estate's MDE are limited by the amount, type and quality of data being inputted and by how well that data is being organised (e.g. through the appropriate use of keywords) to allow for organisations to find and access it. Under the national programme there should be a dedicated budget for data management (to go towards storage and access).

A national seabed mapping programme could also provide an important platform to demonstrate the use of marketable and exportable technologies such as AUVs in the marine robotics field, run competitions and generate export and productivity growth opportunities in the future. By showcasing these technologies, a national programme could help attract further research and innovation funding, which can cement the UK's position as a leader in the marine robotics field and help secure European and other funding to supplement its baseline budget for survey work.

## 7.3 Risks and Challenges

The key challenges presented by a national programme include:

- The identification and decision on the prioritisation of the survey areas is likely to be a difficult process, and is likely to require re-evaluation on at least an annual basis;
- The varying needs of users may not be satisfied with a single common data standard;
- There is no established organisation ready to coordinate the national programme; and
- The potential for economies of scale in terms of capital investment in technology and skills across the UK is limited relative to Option 2 (full implementation).

The most important challenge presented by Option 1 is how the national programme will prioritise the areas of significant need to be mapped on an annual basis, while at the same time meeting the needs of the various stakeholders. Determining a decision-making framework for how to prioritise which areas will be mapped year-on-year will be critical to the success of a national programme.

## 7.4 Suggested Next Steps

The evidence presented in this scoping study suggests that progressing the recommended Option 1 for a national seabed mapping programme will first require the relevant public and private sector organisations and industries to come together, assess the findings of this scoping study and agree to work collaboratively to:

1. Consolidate existing public sector mapping programmes under a new, authoritative body;
2. Ensure that, where possible, seabed survey activities collect data on all parameters of national interest (bathymetry, geology, hydrology, biology) and to a consistent standard;
3. Consolidate existing data management activities into one coherent activity; and
4. Explore options for encouraging or incentivising private sector surveyors for seabed survey work that is collected and shared in accordance and coordination with the public sector programme.

As stated in Section 7.1.2, any initiative that leads to a national coordinated programme would require options for increased funding to be explored from public, private and external sources.

The immediate next step should be building on the work undertaken in this scoping study and developing a detailed business plan for this delivery option. The business plan will need to explore in more detail:

- the extent of the potential for duplication of surveying activities;
- the scope of the national programme and how it will be managed and funded, including an option for a fund for private sector cost recovery;

- how the data will be managed and funded;
- what variables will feature in the decision-making framework for prioritisation of areas to map, and how that prioritisation will take place;
- a time-plan for the activities;
- an identification of the stakeholders that will need to be involved in the decision-making process;
- what the consultation process will be e.g. via four stakeholder meeting groups a year (one every quarter); and
- options for which organisation or partnership of organisations would be best suited to lead the programme, or perhaps if a new body with combined staff from various interested parties will need to be created.

Once a detailed framework of the national programme has been outlined, it will be necessary for the business plan to also seek to establish, in quantitative terms, the programme's funding requirements on an annual basis and how these costs can be met. The assumptions in the model will need to be critically tested, including those assumptions relating the overlap of surveying effort.

Additionally, the governance structure and framework for a national programme will also need to be considered further. It is evident that a number of partnerships and collaborative working are already undertaken by a range of organisations involved with seabed mapping. In order for the national programme to succeed, a national programme will be required to build on this experience and provide a coherent framework for the management and delivery of seabed mapping in the UK. Strong leadership from the private and public sectors working collaboratively together will be essential for progressing and driving forward a national seabed mapping programme.

Finally the business plan should also propose Key Performance Indicators (KPIs) that would be used to evaluate the success of the national programme. These KPIs will need to relate to the resourcing of the programme (e.g. total annual spend, net annual spend, annual operating spend, etc.), its inputs (e.g. staff levels, total vessel days, profile of capital assets, etc.), its outputs (e.g. total square kilometres area mapped, locations mapped at sea, number of identified publications from data, additional funding or additional number of projects per year due to data delivered by programme, etc.) and its outcomes (e.g. feedback from key stakeholders, levels of public/private data users, significant project developments, etc.).



# APPENDICES

## A.1.0 Appendix 1: Interview Topic Guide

Question	Notes
<b>Introduction</b>	
<ul style="list-style-type: none"> <li>• Thank interviewee for agreeing to be interviewed.</li> <li>• Re-introduce self and company. Either:               <ul style="list-style-type: none"> <li>○ Eunomia (as an independent research consultancy); or</li> <li>○ Cefas (providing strategic support to Eunomia, not on behalf of Defra).</li> <li>○ If interviewee is concerned about Cefas conducting the interview, offer the option for Eunomia to take over.</li> </ul> </li> <li>• State that we are doing some work on behalf of BIS and MCA undertaking a scoping study for a UK national seabed programme.</li> <li>• As part of this we are looking to speak with stakeholders to discuss what data is currently being used and how, and provide opportunity to feed-in to how a national seabed programme might be designed.</li> <li>• Confirm that now is a good time to speak and that the discussion will take 30-45 minutes.</li> <li>• Reassure that what the interviewee says is confidential. It will not be possible to identify anyone in the public-facing outputs of the research.</li> <li>• Request permission to record the interview. Explain reasons for doing so: “we would like an accurate record of your views and it allows us to listen to what you have to say, rather than writing down notes. The data will be stored securely in accordance with the Data Protection Act 1998. We do not share the recordings with anyone other than our immediate research team and the recordings are destroyed after the research is finished.” Do not record if no permission is granted.</li> <li>• Ask if they have any questions before we begin?</li> </ul>	
<p><b>Question 0.1:</b> Is your organisation currently involved in any seabed mapping activities?</p> <p>If <b>Yes:</b> direct to Topic 1</p> <p>If <b>No:</b> direct to Question 0.2</p>	
<p><b>Question 0.2:</b> Will you be involved in any seabed mapping activities within the foreseeable future (10 years if asked)?</p> <p>If <b>Yes:</b> direct to Topic 1</p> <p>If <b>No:</b> direct to Topic 2</p>	

Question	Notes
<b>Topic 1: Seabed Mapping Activities</b>	
<p><b>Question 1.1:</b> Could you provide me with a high level overview of the seabed mapping activities you are currently involved with (or are planning to be involved in in the foreseeable future)?</p> <p><i>Specifically: programme name, lead organisation, geographical scope, priority areas which are of most value, frequency of activities, <b>co-ordination with other programmes</b>, programmes in the pipeline</i></p> <p><i>Clarify if they will be: (i) the lead organisation for the work (if not, who will be); (ii) if they will be funding the work (if not, who will be); and/or (iii) if they will be collecting the seabed mapping data (if not, who will be).</i></p>	
<p><b>Question 1.2:</b> What type of equipment, vessels and technologies are currently being used (or are they planning to use)?</p>	
<p><b>Question 1.3:</b> What is the motivation for doing the work and why?</p> <p><i>Specifically: what are the drivers for doing the work and what constraints currently exist that they're seeking to address.</i></p> <p><i>Probes: What information is being collected? Is it a statutory duty? Is it for other reasons e.g. data that currently exists is of poor quality and/or hard to access due to cost?</i></p>	

Question	Notes
<p><b>Question 1.4:</b> Could you provide me with some of the project's financial details?</p> <p><i>Specifically: main source of funding, annual budget, budget continuity (e.g. long/short term, fixed project, one off survey), funding priorities (e.g. specific geographical areas considered to be of higher value)</i></p>	
<p><b>Question 1.5:</b> Are you aware of any other organisations (whether public or private) conducting surveys in the same area/s as you? If so, can you estimate the coverage (%) of the area duplicated?</p> <p><i>Probes: If yes, is there any reason why you doesn't make use of the existing data?</i></p>	
<p><b>Question 1.6:</b> How many people are/will be involved in the design of the survey? How many people are/will be involved in its procurement?</p> <p><i>Probes: FTE? Over how long?</i></p>	
<p><b>Question 1.7:</b> How many people are/will be involved in undertaking the survey?</p> <p><i>Probes: FTE? Over how long?</i></p>	
<p><b>Topic 2: Seabed Mapping Data</b></p>	

Question	Notes
<p><b>Question 2.1:</b> Do you provide data to other organisations?_If so, what type of data do you provide? Are you selling it or is it free of charge?</p> <p><i>Probes: who are you providing it to? Why? What is the data being used for?</i></p> <p><i>Prompts: Multibeam, Single beam, Sidescan sonar, Seismic (sub-bottom), water column data, Sediment sampling, Biological sampling, Video/ROV observations, Lidar, Maritime archaeology</i></p> <p><i>Probe: How much for? On a licence basis? How frequently?</i></p>	
<p><b>Question 2.2:</b> Do you use data from other organisations? If so, how are you using the data? Are you purchasing it or is it free of charge?</p> <p><i>Probes: who are you providing it to? Why? What is the data being used for?</i></p> <p><i>Prompts: bathymetric, environmental, geological, biological and/or other</i></p> <p><i>Probe: How much for? On a licence basis? How frequently?</i></p> <p><b>If No</b> to both Question 2.1 and 2.2: direct to Topic 3.</p>	
<p><b>Question 2.3:</b> How is the data stored and managed and who is it accessible to?</p> <p><i>Prompt (storage): Data Archive Centre, Industry Data Portal</i></p> <p><i>Prompt (accessibility): Public access, Metadata only, Private access only</i></p>	
<p><b>Question 2.4:</b> <u>If you're providing</u>, is there a separate budget for data storage?</p>	

Question	Notes
<p><b>Question 2.5:</b> What is the value of the data (economic, technological and environmental)? Can this be quantified?</p> <p><i>Probes: increased efficiencies, skills, R&amp;D, innovation, specific products and services, de-risk investment</i></p>	
<p><b>Topic 3: Views on the Introduction of a National Programme</b></p>	
<p>Introduction: Although the exact specification of a national seabed mapping programme has not been defined, we understand that the purpose of such a programme would be to further coordinate and centralise seabed mapping activities in the UK. This would be done by incorporating, complimenting or even replacing existing programmes, covering bathymetric, geological, environmental, biological and other survey types. The aim of the programme will be to yield benefits for planning, businesses and the environment, e.g. improving the quality and access to data and de-risk investment. The purpose of this scoping study is therefore to establish if such a programme would be beneficial and what it might look like, and the following questions seek to explore this further.</p>	
<p><b>Question 3.1:</b> Do you think there's a need for a national seabed mapping programme?</p> <p><i>Probes: Could such a programme replace your current activities? What would be the aims/objectives of a national programme? What would happen if there is no national programme?</i></p>	
<p><b>Question 3.2:</b> What do you think would be the advantages of such a scheme and what opportunities might it bring?</p> <p><i>Probes: Could it improve coordination amongst stakeholders? Could it accelerate activities? Could it help improve access to data already available but perhaps too costly? Could it help improve the quality of data being gathered? What current constraints could it help resolve?</i></p>	

Question	Notes
<p><b>Question 3.3:</b> What do you think would be the disadvantages of such a scheme and what risks might be associated with it?</p> <p><i>Probes: Monopoly creation, competition effects, drive business down</i></p>	
<p><b>Question 3.4:</b> Are you aware of any potential sources of funding for a national seabed mapping programme?</p> <p><i>Prompts: public/private, thoughts on how it could be funded</i></p>	
<p><b>Question 3.5:</b> Do you have any opinions or suggestions on how a successful national programme might be managed?</p> <p><i>Prompts: private/public, data storage and ownership, how it might be shared and at what price</i></p>	
<p><b>Question 3.6:</b> If there was a national programme, what would be needed in terms of equipment and methods to carry out the surveys?</p>	
<p><b>Question 3.7:</b> What should the priorities of a national programme be to maximise its value?</p> <p><i>Probes: geographical regions, areas which are the most valuable, type of mapping (i.e. geological, environmental, bathymetric), accelerating pace of activities, improving quality and access to data.</i></p>	

Question	Notes
<p><b>Question 3.8:</b> What do you think would be the main <i>additional</i> benefits from introducing a national programme (economic, technological and environmental)? Can these be quantified?</p> <p><i>Probes: increased efficiencies, new products, services and technologies, skills, R&amp;D, innovation, de-risk investment, potential for developing and exporting, improved access to data, improved data quality, access to data that is currently too expensive</i></p>	
<p><b>Question 3.9:</b> What sectors/organisations do you think would be the biggest beneficiaries of a national programme?</p> <p><i>Specifically: with regards to additional benefits that the programme would bring</i></p>	
<p><b>Question 3.10:</b> What type of outputs would you like to see from a national programme?</p> <p><i>Prompts: data, charts, maps</i></p>	
<b>Sign-off</b>	
<ul style="list-style-type: none"> <li>• Thank interviewee for their time and offer to send through the topic guide to them to add any additional comments or to respond to questions you might not have managed to get through during the call.</li> <li>• Inform interviewee of next steps – we are speaking with a variety of stakeholders in both the public and private sectors. These findings will feed into a report outlining how a national seabed mapping programme might be delivered, and the economic and technology benefits associated with one to be finalised early next year.</li> <li>• Any questions?</li> </ul>	



## A.2.0 Appendix 2: Interview Contact List

The following organisations were contacted for the purposes of contributing to this scoping study.

Organisation	Sector	Contributed to the Scoping Study
British Geological Survey	Public	Yes
Channel Coastal Observatory	Public	Yes
DECC	Public	Yes
Defra	Public	Yes
Environment Agency	Public	Yes
MAREANO	Public	Yes
Marine Management Organisation	Public	Yes
Maritime & Coastguard Agency	Public	Yes
MEDIN	Public	Yes
National Oceanography Centre	Public	Yes
The Crown Estate	Public	Yes
UK Hydrographic Office	Public	Yes
Welsh Government	Public	Yes
Department of Environment Northern Ireland	Public	Yes
Marine Scotland	Public	Yes
British Marine Aggregate Producers Association	Private	Yes

<b>Organisation</b>	<b>Sector</b>	<b>Contributed to the Scoping Study</b>
<b>BP</b>	Private	Yes
<b>Carbon Capture Storage Association (CCSA)</b>	Private	Yes
<b>Envision</b>	Private	Yes
<b>Fugro</b>	Private	Yes
<b>Gardline</b>	Private	Yes
<b>Marine Industries Leadership Council</b>	Private	Yes
<b>Open Hydro</b>	Private	Yes
<b>ORE Catapult</b>	Private	Yes
<b>Pelgian international</b>	Private	Yes
<b>Royal Yachting Association</b>	Private	Yes
<b>Seabed User and Developer Group</b>	Private	Yes
<b>Sustainable Marine Energy</b>	Private	Yes
<b>UK Cable Protection Committee</b>	Private	Yes
<b>UK Hydrographic Society</b>	Private	Yes
<b>Marine Institute Ireland</b>	Public	No, but invited
<b>Natural Capital Committee</b>	Public	No, but invited
<b>Oil &amp; Gas Authority</b>	Public	No, but invited
<b>ABP</b>	Private	No, but invited
<b>British Marine Federation</b>	Private	No, but invited
<b>British Ports Association</b>	Private	No, but invited

<b>Organisation</b>	<b>Sector</b>	<b>Contributed to the Scoping Study</b>
<b>DONG</b>	Private	No, but invited
<b>Northern Lighthouse Board</b>	Private	No, but invited
<b>Oil &amp; Gas UK</b>	Private	No, but invited
<b>RenewableUK</b>	Private	No, but invited
<b>Scottish Power Renewables</b>	Private	No, but invited
<b>Statkraft</b>	Private	No, but invited
<b>Trinity House</b>	Private	No, but invited
<b>UK Chamber of Shipping</b>	Private	No, but invited
<b>WWF</b>	Private	No, but invited

## A.3.0 Appendix 3: Cost-Benefit Assumptions

### A.3.1 Administrative Model: Standard Cost Model Assumptions

The Standard Cost Model has been applied to the estimation of administrative impacts associated with undertaking seabed mapping in the baseline and options scenarios. The key assumptions, together with rationale and sources for the same, which are applied to the establishment of each of these, are summarised respectively below:

#### A.3.1.1 Baseline Assumptions

Assumption	Input	Rationale	Source
<b>Median earnings for FTEs in the public sector, UK, April 2015</b>	£589.00 per week (5 days)	This rate has been applied for all procurement and data management activities.	<a href="http://www.ons.gov.uk/ons/dcp171778424052.pdf">http://www.ons.gov.uk/ons/dcp171778424052.pdf</a>
<b>Median earnings for all FTEs, UK, April 2015</b>	£528.00 per week (5 days)	This rate has been applied for all activities involving coordination of existing seabed mapping initiatives.	<a href="http://www.ons.gov.uk/ons/dcp171778424052.pdf">http://www.ons.gov.uk/ons/dcp171778424052.pdf</a>
<b>Baseline No. of organisations – (Coordination &amp; Scoping)</b>	25	Includes MCA-DEFRA MoU signatories and MAREMAP partners. Organisations that are involved in both are counted only once. MEDIN has been excluded as no break-up of the 30+ members among private and public sectors was available, and significant overlap with MAREMAP and MoU public organisations is anticipated.	<a href="https://www.gov.uk/guidance/share-hydrographic-data-with-maritime-and-coastguard-agency-mca">https://www.gov.uk/guidance/share-hydrographic-data-with-maritime-and-coastguard-agency-mca</a> ; <a href="http://www.maremap.ac.uk/view/information/about.html">http://www.maremap.ac.uk/view/information/about.html</a>
<b>Baseline No. of organisations (Procurement and Data Management)</b>	42	All those included in coordination activities, as well as Port & Harbour Authority Programmes, DECC, Inshore Fisheries and Conservation Authorities, and others, particularly private sector.	ABPMer, Cefas, <i>ME5408: Marine Survey Needs to Underpin Defra Policy Needs</i> , July 2010

Assumption	Input	Rationale	Source
<b>Baseline No. of employees (FTEs) in all activities</b>	2-4 per activity	4 in coordination; 2-3 in procurement and data management	Eunomia estimate on the basis of information from interviews.
<b>Baseline effort (days) and frequency of tasks p.a. (Coordination &amp; Scoping)</b>	15 days x 1	This includes meetings with other organisations, management of funding and staffing arrangements, sharing of data etc.	Eunomia estimate on the basis of information from interviews.
<b>Baseline effort (days) and frequency of tasks p.a. (Procurement)</b>	9 days (4 procurement process and design + 5 contract management) x 12	Procurement activities estimated to be undertaken once a month.	Eunomia estimate on the basis of information from interviews.
<b>Baseline effort (days) and frequency of tasks p.a. (Data Management)</b>	10 days (3 data storage + 7 formatting and QA) x 12	Need for procurement activities estimates to be needed once a month.	Eunomia estimate on the basis of information from interviews.

### A.3.1.2 Options Assumptions

Assumption	Input	Rationale	Source
<b>Median earnings for all FTEs, UK, April 2015</b>	£528.00 per week (5 days)	This rate has been applied for all procurement and data management activities.	<a href="http://www.ons.gov.uk/ons/dcp171778_424052.pdf">http://www.ons.gov.uk/ons/dcp171778_424052.pdf</a>
<b>Median Full-time gross weekly earnings for Managers, Directors and Senior Officials, UK, April 2015</b>	£784.10 per week (5 days)	This rate has been applied to the identification and determination/ consultation processes associated with the priority areas scenario, assuming individuals at more senior levels will be involved.	<a href="http://www.ons.gov.uk/ons/dcp171778_424052.pdf">http://www.ons.gov.uk/ons/dcp171778_424052.pdf</a>
<b>Options No. of organisations – (Coordination &amp; Scoping)</b>	42	Driven by baseline assumptions – assuming that all organisations considered will be involved.	Eunomia estimate on the basis of information from interviews.
<b>Options No. of organisations – (Procurement and Data Management)</b>	4 (Option 1); 5 (Option 2)	This reflects the streamlining of currently separate procurements carried out for each organisation. It is assumed that a lead organisation will be identified to handle areas associated with each of the three	Eunomia estimate on the basis of information from interviews.

Assumption	Input	Rationale	Source
		different data types.	
<b>Options No. of employees (FTEs) in all activities</b>	3-8	This reflects a larger scale of operations required to deliver all three types of data and liaise with private contractors.	Eunomia estimate on the basis of information from interviews.
<b>Options effort (days) and frequency of tasks p.a. (Coordination of existing activities)</b>	<b>Option 1:</b> 18 x 1 <b>Option 2:</b> 20 x 1	This includes meetings with other organisations, management of funding and staffing arrangements, sharing of data etc. and is lower than the baseline in order to reflect the impact of a focussed national programme rather than isolated initiatives.	Eunomia assumption based on literature review and interviews.
<b>Options effort (days) and frequency of tasks p.a. (Identification and Determination of Priority Areas)</b>	<b>Option 1:</b> 20 (16 identification) + 16 consultation) x 1 <b>Option 2:</b> 30 (18 identification) + 18 consultation) x 1	This assumption has been applied for Options 1 and 2.	Eunomia Assumption based on literature review and interviews.
<b>Options effort (days) and frequency of tasks p.a. (Procurement)</b>	<b>Option 1:</b> 77 (31 procurement + 38 contract management) x 6 <b>Option 2:</b> 38 (20 procurement + 25 contract management)x 10	This reflects fewer procurement rounds undertaken as compared to the baseline scenario. Also reflects a greater number of procurement rounds to be delivered in a shorter timeframe under Option 2 relevant to Option 1.	Eunomia estimate on the basis of information from interviews.
<b>Options effort (days) and frequency of tasks p.a. (Data Management)</b>	<b>Option 1:</b> 54 x 6 ; <b>Option 2:</b> 35 x 10	This reflects a more streamlined approach to data management under the options compared to the baseline (represented by a lower frequency of activities); with greater effort representing the increased focus on standardised, high quality data in centralised repositories.	Eunomia estimate on the basis of information from interviews.

## A.3.2 Baseline Data – Average Annual Budget of UK Seabed Mapping Programmes

Programme	Public/ Private	Programme Classification	Mapping Data type	Mapping Method	Geographic Scope	Mapping Service Provider	Continuity (up to next 10 yrs)	Coordination	Data Access	Budget Data						
										Programme Budget (£M)	Duration (years)	Average annual budget (£M)	Data Year	Base year Annual budget (£M real terms)	Base year Average Annual Budget (£M)	
Civil Hydrography Programme	Public	Main	Bathymetric	Multibeam	UK Whole	Survey contractor	Yes	Medium	Open	£6.77	1	£6.77	2013	£6.94	£6.37	
				Environmental						Single beam	£5.54	1	£5.54	2012		£5.80
				Geological						Sidescan sonar						
			Other	Watercolumn data												
The National Network of Regional Coastal Monitoring	Public	Main	Bathymetric	Unknown	Regional - UK	Survey contractor	Yes	Medium	Open	£4.67	1	£4.67	2015	£4.67	£4.67	
MAREMAP	Public	Main	Geological	Multibeam	UK Whole	Research/Academic Institute	Unknown	Medium	Open	£1.00	1	£1.00	2014	£1.01	£1.01	
			Geological	Sediment sampling												
MCZ Evidence Programme	Public	Main	Bathymetric	Multibeam	England	Government	Unknown	Medium	Open	£7.00	2	£3.50	2011	£3.73	£2.37	
				Environmental						Single beam	£3.50	2	£3.50	2012		£3.66
				Geological						Sidescan sonar	£1.05	2	£1.05	2014		£1.06
				Other						Sediment sampling	£2.10	2	£1.05	2015		£1.05
AVERAGE (Median) COST p.a.															£3.69	

Programme	Public/ Private	Programme Classification	Mapping Data type	Mapping Method	Geographic Scope	Mapping Service Provider	Continuity (up to next 10 yrs)	Coordination	Data Access	Budget Data							
										Programme Budget (£M)	Duration (years)	Average annual budget (£M)	Data Year	Base year Annual budget (£M real terms)	Base year Average Annual Budget (£M)		
INIS Hydro	Public	Other/Noteworthy	Bathymetric	Multibeam	Scotland, NI, Ireland	Government	No	Low	Open	£3.20	3.25	£0.98	2011	£1.05	£1.02		
				Watercolumn data		Research/Academic Institute						£0.98	2012	£1.03			
				Sediment sampling		Survey contractor						£0.98	2013	£1.01			
			Geological	Maritime archaeology													
Regional Environmental Characterisation Surveys*	Public	Other/Noteworthy	Bathymetric	Multibeam	England	Government	No	Medium	Open	£22.62	9	£2.51	2002	£3.39	£3.04		
				Sidescan sonar		Government						£2.51	2003	£3.31			
				Seismic (sub-bottom)		Government						£2.51	2004	£3.21			
				Sediment sampling		Government						£2.51	2005	£3.12			
				Biological sampling		Research/Academic Institute						£2.51	2006	£3.03			
				Video/ROV observations		Research/Academic Institute						£2.51	2007	£2.94			
				Maritime archaeology		Research/Academic Institute						£2.51	2008	£2.87			
				Other		Survey contractor						£2.51	2009	£2.80			
				Other		Survey contractor						£2.51	2010	£2.72			
													Other	Other			
UK Continental shelf Seismic Campaign	Public	Other / Noteworthy	Other	Seismic (sub-bottom)	UK Whole	Survey contractor	Unknown	Low	Unknown	£20.00	1	£20.00	2014	£20.20	£20.20		
MEDIN	Public	Other / Noteworthy	Other	Other	UK Whole	All	Yes	High	Open	£7.50	3	£2.50	2008	£2.85	£2.50		
												£2.50	2009	£2.79			
												£2.50	2010	£2.70			
												£6.81	3	£2.27		2011	£2.42
												£2.27	2012	£2.37			
												£2.27	2013	£2.33			
£4.50	2	£2.25	2014	£2.27													
			Other	Other													
AVERAGE (Median) COST p.a.															£2.75		

