National Oceanography Centre



OCEAN IMPACT

HOW THE NATIONAL OCEANOGRAPHY CENTRE TURNS OCEAN KNOWLEDGE AND INNOVATION INTO VALUE FOR SOCIETY

NOVEMBER 2026



EXECUTIVE SUMMARY



The National Oceanography Centre (NOC) generates substantial economic, scientific, environmental and societal value by combining world-leading ocean research with the national infrastructure, technology and expertise needed to translate knowledge into practical action.

This study assesses NOC's contribution to the economy and society over the four-year period from October 2021 to September 2025. Drawing on economic modelling, consultation evidence and impact case examples, it provides a robust, evidence-based analysis of NOC's contribution to local and national economies, and its wider research and innovation impacts.

WHAT MAKES NOC DISTINCTIVE

NOC is the UK's leading oceanographic institution and one of the world's foremost centres for ocean science and innovation.

NOC's impacts are underpinned by four distinctive strengths:

SCALE AND REACH:
the UK's largest concentration of marine science, technology and research operations expertise, with capabilities spanning coastal environments to the deep ocean

INTEGRATION:
a distinctive combination of scientific, engineering, operational and digital expertise that connects research, technology development and real-world application

LONG-TERM CAPACITY AND OUTLOOK:
decades of experience in leading observations, infrastructure management, technology development, and partnerships enable NOC to address complex challenges that require long-term evidence and continuity

CREDIBILITY:
a trusted and independent source of evidence, with strong relationships across government, policy and international marine science communities.

As the provider and convener of national capability, NOC enables research and innovation across the wider UK marine science community through its research vessels, autonomous systems, specialist facilities and marine data infrastructure.

NOC'S IMPACT:
A MORE RESILIENT, SUSTAINABLE AND SECURE SOCIETY

NOC generates and applies scientific knowledge to help governments, public agencies, businesses and communities anticipate, understand and respond to major environmental, economic and societal challenges.

NOC has strengthened the UK's resilience to coastal hazards through observations, modelling and the provision of specialist expertise and advice to partners. A key route to impact is generating evidence to improve flood forecasting and coastal risk management, including informing the Environment Agency's operation of the Thames Barrier – which protects over 1.4 million people, £320 billion of residential property and 300km of major roads.

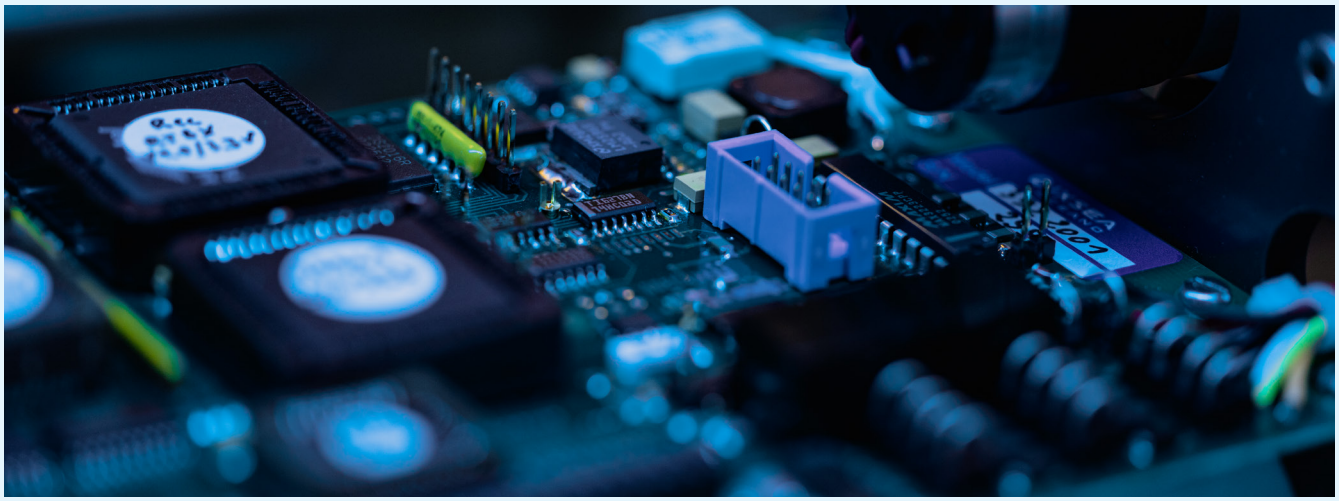
Through programmes such as autonomous ocean monitoring, NOC provides data used by the Met Office to improve weather forecasts, storm-surge predictions and advance warnings of extreme weather, helping government, infrastructure operators and communities better prepare for environmental risks and reducing the societal and economic costs associated with severe weather events.

Research on subsea cable networks has strengthened the resilience of critical digital infrastructure. NOC's work helps governments and industry better understand and manage risks to systems that carry over 90% of UK international data traffic and support an estimated £1.4 trillion of UK cross-border transactions each day, reducing the risk and cost of disruption to communications, connectivity and economic activity.



NOC has supported more sustainable management of the ocean through research on biodiversity, ecosystem change and blue carbon, while also helping shape international frameworks for ocean protection. Through contributions to initiatives such as the Biodiversity Beyond National Jurisdiction Agreement (BBNJ), and enhancing understanding of the environmental impact of deep-sea mining to inform strategic planning and decision-making, NOC has helped ensure that opportunities for economic development are balanced against the long-term protection of marine ecosystems and ocean resources.

An emerging area of impact is national security. NOC's expertise in marine autonomy, sensors and subsea environments is increasingly being used to support collaborative activity with the Royal Navy, Defence Science and Technology Laboratory (Dstl) and other defence organisations. This is enabling the UK and its allies to remain at the forefront of technology development and application in complex maritime environments. NOC's wider research on critical infrastructure, geohazards and climate change also underpins wider national resilience and preparedness.



NOC'S IMPACT:
A STRONGER ECONOMY, ENHANCED INNOVATION AND THE GROWTH OF SUSTAINABLE MARINE INDUSTRIES

NOC strengthens the economy by translating research into innovation, helping businesses solve challenges, creating the conditions for new products and services and supporting the growth of marine industries.

NOC translates scientific research into economic opportunities through commercial services and industry partnerships. NOC's expertise is increasingly being applied in sectors beyond traditional marine science, including offshore energy, environmental management, defence, insurance and financial services. Commercial income increased from £1.1m in 2021/22 to £8.3m in 2024/25, with around 350 UK organisations purchasing commercial services from NOC during the impact period, including around 70 organisations based in the Hampshire and Solent Combined County Authority area and 15 organisations based in the Liverpool City Region Combined Authority area.

NOC's impact extends beyond the services it delivers directly. Technology licensing has enabled innovations developed at NOC to reach new markets and users, allowing research outputs to be manufactured, deployed and scaled by industry. Five technology licences have been completed in the last five years, with an estimated value to NOC of more than £15m between 2020 and 2035. Many of these innovations – for example in sensors or autonomous systems – are best understood as enduring assets for the UK: once developed, they continue to generate value through repeated use and application across industry and research, rather than through a single, one-off return. Further, NOC has identified around 85 IP opportunities, which are being considered for protection, licensing, and commercialisation, and several potential spinout opportunities were being actively considered by NOC in mid-2026.

NOC also plays an important role in strengthening the wider marine innovation ecosystem. Through its Innovation Hub at its Southampton facility, and by hosting major events such as Ocean Business, NOC brings together businesses, researchers, investors and technology developers, supporting business growth, collaboration and the diffusion of new ideas and technologies across the sector. Over the past five years, NOC reports that the Innovation Hub has supported the growth of 15 start-ups, which have created an estimated 55 jobs in total, while Ocean Business attracted around 6,000 visitors to Southampton at its most recent edition.

NOC has also pioneered new models of collaboration between science and industry. Through BORA Blue Ocean Research Alliance® with Subsea7, a global offshore energy services company, NOC leveraged more than £2 million of industry investment and demonstrated how commercial offshore operations can be transformed into platforms for scientific research, generating new scientific knowledge while creating value for both industry and society.

NOC'S IMPACT: QUANTIFIED ECONOMIC VALUE

NOC generates significant economic value for both local and national economies through its research, commercialisation and operational activity.

Many of NOC's most significant impacts are realised through improved resilience, environmental protection, scientific advancement and evidence-based decision-making. These will have long-term societal benefits, but they cannot be fully captured in monetary terms. However, the study has quantified three dimensions of economic value: operational impacts, commercial impacts, and the longer-term productivity benefits expected to arise from UKRI-funded activity undertaken during the impact period.

Over the four-year impact period, NOC's operations and commercial activities generated an estimated £455m in gross value added (GVA)[1] across the UK economy and supported an average of approximately 1,500 jobs per year. At the local level, NOC generated an estimated £218m GVA over the four-year period in the Hampshire and Solent Combined County Authority area and £54m GVA in the Liverpool City Region Combined Authority area, while supporting an average of approximately 700 and 170 jobs per year respectively.

Beyond these immediate impacts, NOC's research can be expected to generate significant future economic benefits. Applying Government-published evidence on the returns to public R&D investment suggests that UKRI-funded activity undertaken by NOC during the impact period could generate an estimated £826-853m in discounted lifetime economic benefits across the wider UK economy, through future improvements in private-sector productivity.

Taken together, this suggests an estimated GVA contribution derived from NOC's activities in the impact period of approximately £1.3bn.



1 All GVA values are expressed in 2025 prices.



CONTRIBUTION TO NATIONAL PRIORITIES

NOC helps the UK deliver on its national strategic priorities across policy domains.

NOC's contribution spans economic development, climate and net zero, and national security priorities. NOC also supports the UK's strategic leadership role in international forums and inter-governmental decision-making processes. A high-level summary of NOC's contribution, demonstrated through the impact study, is set out in Table 1-1 below.

Table 1-1: Alignment with UK priorities

Policy area	Examples of NOC contribution
Growth in every postcode	£1,281-1,308m economic value supported Supply-chain benefits for marine-related industries across the UK Significant local employment in Hampshire and Solent and Liverpool City Region
Innovation and enterprise	Commercialisation and technology transfer, including via technology licensing, commercial services, and industry partnerships Start-up support and business growth via the Innovation Hub
Skills and workforce development	Employment and training opportunities in engineering and technical marine operations roles Development of the next generation of marine scientists, through partnerships with universities including doctoral training
Climate adaptation and resilience	Long-term ocean observations, ocean and climate modelling, coastal resilience research, technology development
Clean energy and net zero	Blue carbon and offshore renewables research and industrial collaboration, deep-sea mining research, carbon capture and storage research
National security	Marine autonomy and subsea infrastructure research and specialist operations, including through formal collaboration with the UK defence and security community Research to support critical infrastructure resilience, and mitigation and response to geohazards and climate tipping points
International leadership	Contribution to the Biodiversity Beyond National Jurisdiction Agreement Advisory and expert roles supporting international ocean science, biodiversity and environmental protection agencies

Source: SQW

NOC's impact also aligns strongly with UKRI's mission to '*advance knowledge, improve lives and drive growth*'. NOC generates new scientific understanding of the ocean, translates that knowledge into societal benefits through improved resilience, sustainability and security, and creates economic value through innovation, commercialisation and support for growing marine industries.



FUTURE OUTLOOK

NOC enters the next phase of its development from a position of considerable strength.

Future impact is likely to be increasingly shaped by its ability to translate research into practical application, expand partnerships across industry and government, and strengthen its role as a trusted voice on major ocean-related challenges in the UK and internationally.

There is also a significant opportunity for NOC to deepen its role as an anchor institution in Southampton and Liverpool, supporting innovation, skills development and enhancing the depth and maturity of marine economy and technology ecosystems, to drive local economic growth.

CONTENTS



02
STUDY PURPOSE, SCOPE AND APPROACH



04
ABOUT THE NATIONAL OCEANOGRAPHY CENTRE



12
ROUTES TO IMPACT FRAMEWORK



16
IMPACTS OF NOC'S RESEARCH, INNOVATION AND STRATEGIC ACTIVITIES: IMPACT CASE EXAMPLES



24
IMPACTS OF NOC'S RESEARCH, INNOVATION AND STRATEGIC ACTIVITIES: WIDER PERSPECTIVES



36
IMPACTS OF NOC'S COMMERCIAL ACTIVITIES



42
IMPACTS OF NOC'S OPERATIONS

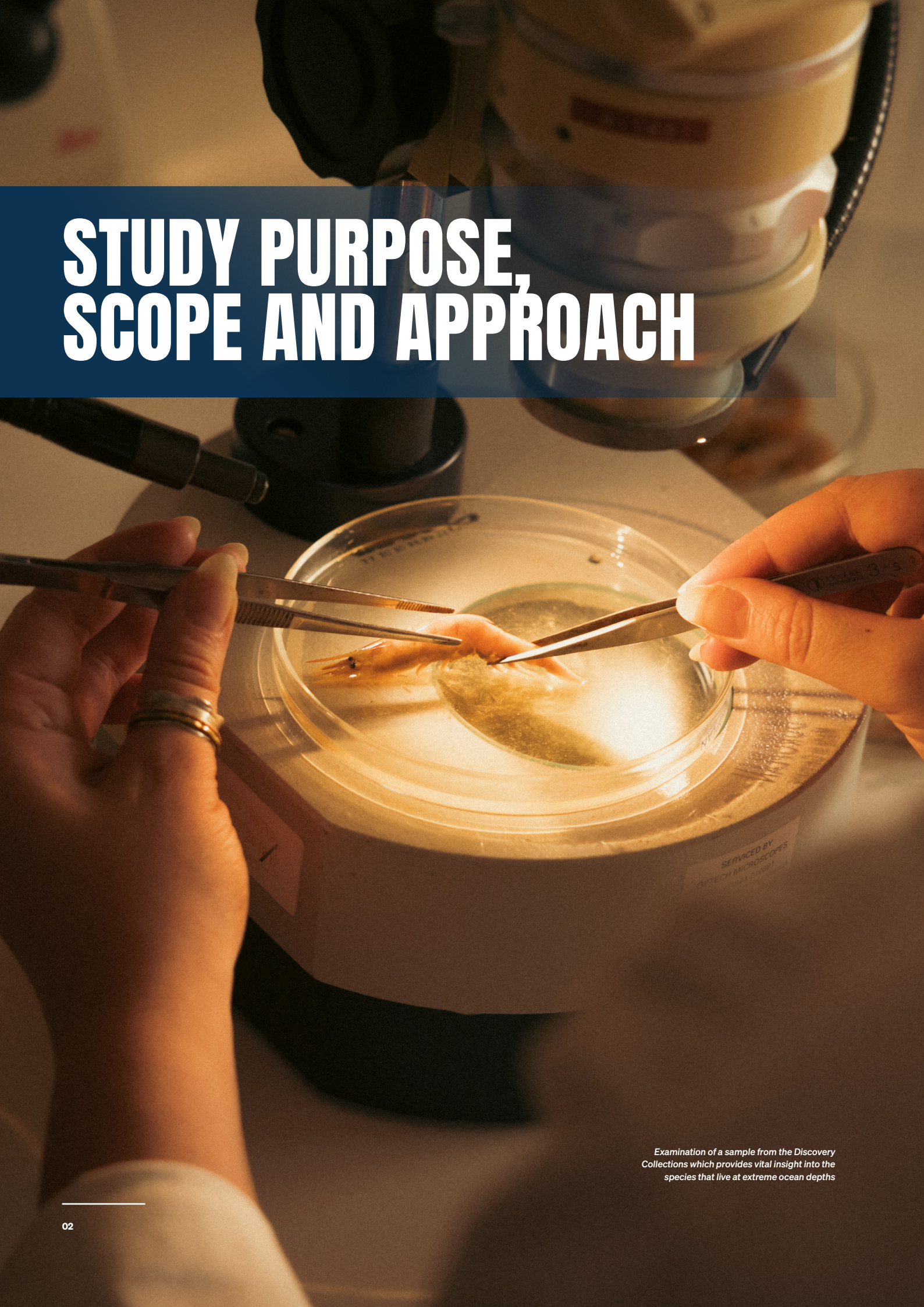


48
IMPACT REFLECTIONS AND FUTURE PROSPECTS

54
ANNEX A: METHODOLOGY AND ASSUMPTIONS

61
ANNEX B: IMPACT CASE STUDY EXAMPLES

STUDY PURPOSE, SCOPE AND APPROACH



Examination of a sample from the Discovery Collections which provides vital insight into the species that live at extreme ocean depths

The National Oceanography Centre (NOC) is one of the world's leading oceanographic institutions. It delivers pioneering marine research and technological innovation, working with partners across the UK and globally, to deepen society's understanding of the ocean and address urgent environmental and societal challenges.

NOC provides national capability in marine science, managing long-term research programmes, collating and providing data and intelligence, and hosting world-class scientific infrastructure and facilities to support the wider marine science community. NOC operates from coastal seas to deep water and is one of few research organisations globally with the equipment and expertise to operate to depths of 6,000m.

SQW was appointed in June 2026 to undertake a socio-economic impact study of NOC. The purpose was to provide a robust, evidence-based analysis of its contribution to local and national economies and its wider research and innovation impacts, including its contribution to international marine science and innovation and strategic impacts.

This included (i) identifying and evidencing through case examples and qualitative research the impacts of NOC's research, technology development and strategic activities and (ii) quantifying where possible the direct and indirect economic impact of NOC's activities. The latter included estimating the economic value to society of NOC's research using Government-published estimates on the productivity effects of public R&D, and quantifying the impacts of commercial and operational activities, including through staff expenditure and supply-chain effects.[2]

The impact study focused on a four-year period from October 2021 to September 2025. This reflected NOC's financial year (which runs from October to September) and the period for which consistent and comprehensive data on staffing, expenditure and commercial income was available.

The study involved primary research with 41 NOC representatives and 18 external partners and stakeholders, and development and population of a bespoke economic impact model based on an agreed 'impact framework' (see Section 3) setting out the routes to impact for NOC's activities.

We would like to thank all individuals involved in the research. We extend particular thanks to Jo Thompson, Director, External Affairs and Impact, and her team, and Andrew Lovett, Director of Finance, for overseeing the study and providing relevant data/documents.

2 This study is not an assessment of the quality, scientific excellence or impact of individual research projects/programmes undertaken by NOC. Further, the scope did not include quantifying the environmental or carbon impacts of NOC's operations or research; NOC's carbon impact is set out in its annual report and financial statement.

ABOUT THE NATIONAL OCEANOGRAPHY CENTRE



RRS Discovery in the Atlantic Ocean during a recent expedition, working with the Met Office and MeteoFrance

PURPOSE AND ACTIVITIES

The purpose of NOC is to gain a deeper knowledge of the ocean to address major challenges facing society and the natural world. NOC has four ocean-related missions:

- **CLIMATE:** Society can plan for, adapt to and mitigate against environmental change.
- **BIODIVERSITY:** Marine biodiversity is protected and thriving.
- **HAZARDS AND POLLUTION:** People, infrastructure and ecosystems are protected from hazards and pollution.
- **SUSTAINABLE MARINE ECONOMY:** Ensure development of marine-based economic activity is sustainable, whilst protecting the ocean's future health.[3]

To deliver against these missions, NOC:

- Undertakes **research** into the global ocean and climate system, marine biodiversity and ecosystems, resources, and society's interaction, spanning the full spectrum from curiosity-driven research to applied research.
- Creates and develops **technology** to advance the frontiers of ocean knowledge, developing and commercialising products/services for industry and other partners.
- Generates and shares global **ocean observations, models and digital tools**.
- Hosts state-of-the-art **facilities and services** that are used by partners nationally and internationally, and operates two research ships which enable scientists and researchers to carry out marine science across the globe.
- **Manages national capability funding** on behalf of Natural Environment Research Council ([NERC], part of UK Research and Innovation), working in partnership with marine centres across the UK.
- Provides **scientific evidence** for national and international public policy development, risk assessment, ocean governance and regulation for sustainable development.
- **Convenes the marine science research community** to enhance its influence on key stakeholders and leads and participates in international partnerships and networks.
- **Informs the public through public engagement and education sector engagement** to enhance understanding of the ocean's role in our lives and an awareness of ocean-related issues that present risk.
- Supports marine science **education and training**, including collaborating with partner universities on undergraduate and postgraduate education, including doctoral training.

3 *NOC Strategy 2025-2035, available here - https://www.noc.ac.uk/sites/default/files/2026-04/STRATEGY 2025-2035 - EXTERNAL.pdf*

PROFILE

THE HISTORY OF NOC

NOC can trace its roots back to the Liverpool Tidal Institute (originally called the Liverpool Observatory), established in 1843 to calculate the longitude and tides of the city to assist in the development of the port, and the National Institute of Oceanography (NIO), established in 1949. In 1965, the Liverpool Tidal Institute and the NIO both became part of the newly formed Natural Environment Research Council (NERC), and later in 1969 merged to form the Institute of Oceanographic Sciences (IOS).

In 1995, the IOS, NERC's Research Vessel Service and University of Southampton's departments of Geology and Oceanography co-located to a new research facility within the Port of Southampton, known as the Southampton Oceanography Centre (SOC). In 2005, SOC became the National Oceanography Centre (NOC), part of NERC. Then in 2019, following the establishment of UK Research and Innovation (UKRI), NOC gained independence to become a self-governing organisation.

At this point, and reflecting its new flexibility as an independent charity, NOC Innovations was established as a wholly owned subsidiary company to translate NOC's marine science into practical solutions for industry.

SITES AND ASSETS

Today, NOC is a four-site organisation, with facilities in Southampton and Liverpool, each co-located with a partner university, and two state-of-the-art research ships: RRS *James Cook* and RRS *Discovery*, both operated on behalf of NERC-UKRI.

NOC also has a fleet of autonomous underwater and surface vehicles, and hosts key facilities:

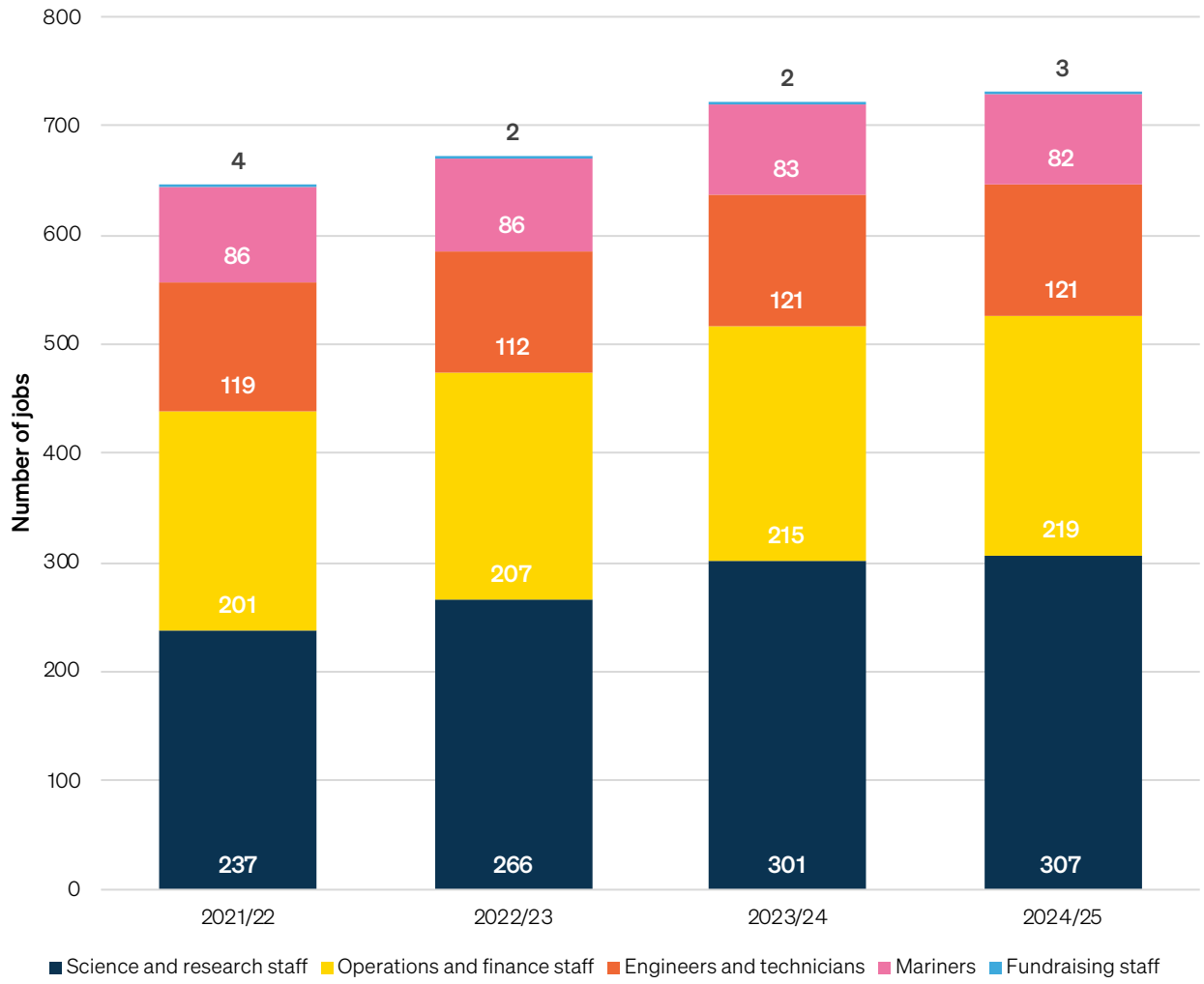
- the National Marine Equipment Pool (NMEP), described by NOC as the largest centralised marine scientific equipment pool in Europe
- the British Oceanographic Data Centre (BODC), the UK's national facility for managing and distributing marine environmental data
- the British Ocean Sediment Core Research Facility (BOSCORF), the UK's largest deep-sea sediment repository and research facility
- the National Oceanographic Library, one of the largest and most significant collections of marine materials in the UK.

NOC Innovations manages the NOC Innovation Hub, a 300 m^2 facility at NOC's Southampton base offering flexible office space and communal space and facilities to bring together companies working across ocean industries, fostering collaboration, growth, and innovation.

PEOPLE

A major employer of highly skilled professionals, NOC directly supported 732 jobs in 2024/25, including scientists, engineers and technicians, operations staff and mariners. Employment grew over the impact period, as shown in Figure 2-1 below.

Figure 2-1: Employment at NOC (number of jobs)



Source: SQW analysis of NOC data. Note: The years refer to NOC's reporting periods which run from October to September

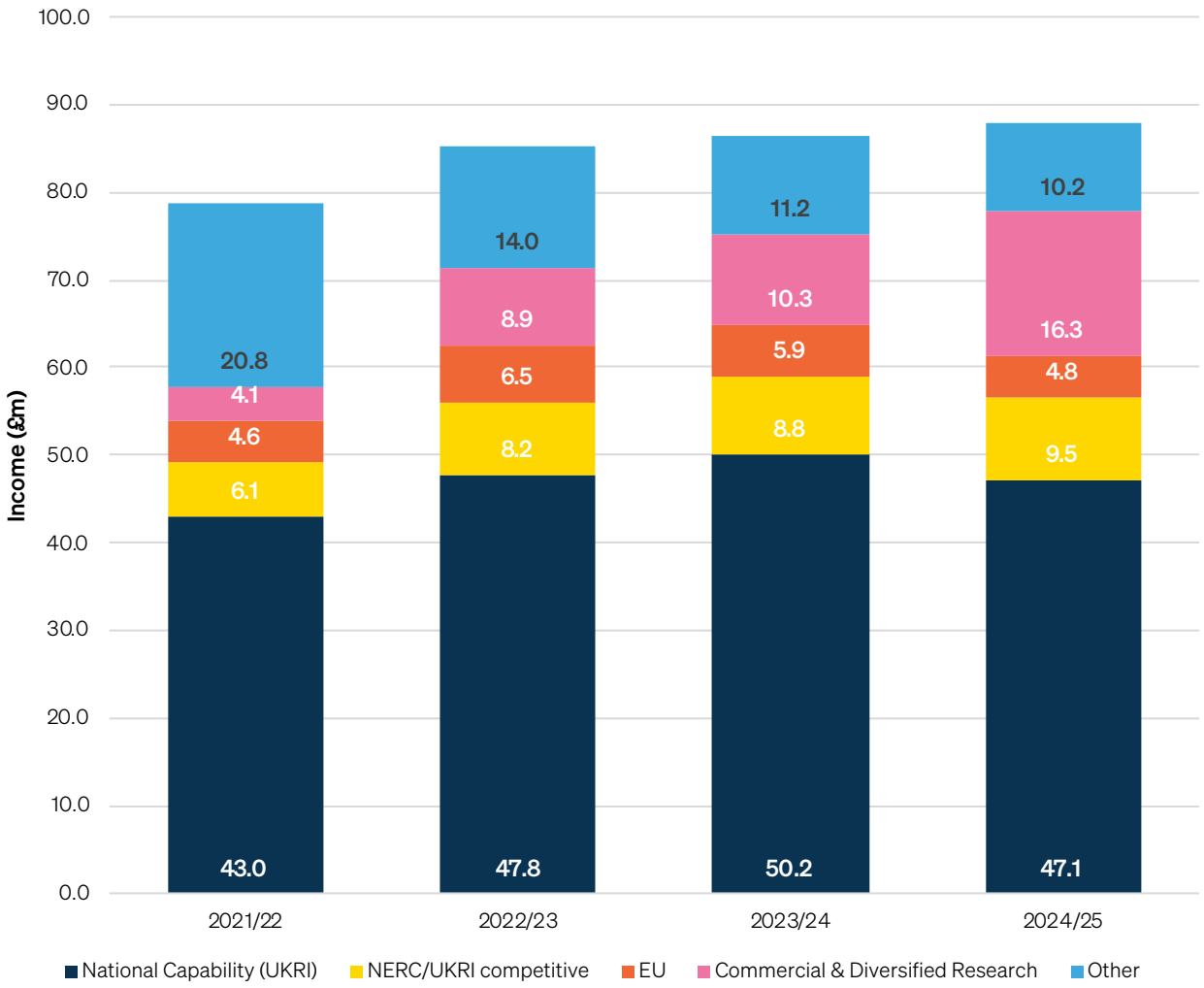
INCOME

NOC's research and innovation activity is funded by multiple sources: National Capability funding from UKRI to support research, observations, data provision and specialist facilities for the marine science community, competitively won research awards from UKRI (including NERC), EU funding, commercial and diversified research income, and other sources including philanthropic awards and donations. Values over the impact period are set out in Figure 2-2.

As shown in the figure, total income has increased consistently over the impact period, reaching approximately £88m in 2024/25 (up from £79m in 2021/22). National Capability (provided by UKRI) accounted for over half of income in each year of the impact period. However, commercial and diversified research income increased substantially over the impact period, from around £4.1m in 2021/22 to £16.3m in 2024/25.

Alongside increased commercial and diversified research income, consultations highlighted the development of a dedicated philanthropy function at NOC, which has begun securing funding and is intended to be an increasingly important source of income over time. Activities already co-funded through philanthropic donations included blue carbon and biodiversity research, plastics research, the development of nature-based solutions, and education and outreach activities. It was reported that engagement with philanthropic partners is supporting the co-design and delivery of impact activities aligned with NOC's missions.

Figure 2-2: NOC income over the impact period



Source: SQW analysis of NOC data. Note: Other includes capital grants from a range of sources including UKRI, NERC support, philanthropic and donations income, facilities income including rental from University of Southampton, and bank interest. The years refer to NOC's reporting periods (October to September)

PARTNERSHIPS AND COLLABORATIONS

NOC collaborates extensively with organisations across the marine science and innovation landscape, in the UK and internationally. Partnerships span universities and research institutes, government departments and public agencies, international scientific and policy bodies, industry and technology companies, funders, charities and education organisations.

These relationships range from long-term strategic partnerships and formal agreements to shared programme delivery, infrastructure exchange, research consortia, commercial licensing and project-specific collaboration.

The figure below sets out the research/academic and governmental and partnership organisations identified as partners and collaborators by NOC in consultations for the impact study. This includes UK and international partners and collaborators. The figure is illustrative, identifying the organisations highlighted in the consultations. This does not reflect all relationships across the organisation, nor does it seek to capture every partner of the Centre (including research project collaborators). However, demonstrating the scope of NOC's partnership network, over 80 organisations were identified by consultees.

Further, this does not include commercial partners, as these relationships may be commercially confidential.

Figure 2-3: NOC partners and collaborators identified in consultations with NOC staff

UK GOVERNMENT BODIES & AGENCIES

Advanced Research and Invention Agency (ARIA)

Centre for Environment, Fisheries and Aquaculture Science (Cefas)

Crown Estate Scotland

Defence Science and Technology Laboratory

Department for Energy Security and Net Zero

Department for Environment, Food and Rural Affairs (Defra)

Department for Business, Innovation, Science and Trade

Department for Transport

Environment Agency

Foreign, Commonwealth and Development Office

House of Lords

Joint Nature Conservation Committee

Marine Scotland

Maritime and Coastguard Agency

Ministry of Defence

Natural England

Natural Environment Research Council

Natural Resources Wales

Royal Navy

Scottish Environment Protection Agency

Scottish Government

The Crown Estate

UK Met Office

UK Research and Innovation (UKRI)

United Kingdom Hydrographic Office

UK RESEARCH & ACADEMIC ORGANISATIONS

Bangor University

British Antarctic Survey

British Geological Survey

UK Centre for Ecology and Hydrology

Centre for Environmental Data Analysis

Challenger Society for Marine Science

Durham University

Environmental Information Data Centre

Heriot-Watt University

Marine Biological Association UK

Marine Climate Change Impacts Partnership

Marine Science UK

National Geoscience Data Centre

Newcastle University

Plymouth Marine Laboratory

Scottish Association for Marine Science

UK Polar Data Centre

University College London

University of Bath

University of East Anglia

University of Exeter

University of Liverpool

University of Oxford

University of Plymouth

University of Southampton

80+ UK AND INTERNATIONAL GOVERNMENTAL, RESEARCH AND ACADEMIC ORGANISATIONS

INTERNATIONAL GOVERNMENT BODIES, AGENCIES AND OTHER CLIMATE SCIENCE ORGANISATIONS

Coastal Zone Management Authority and Institute (Belize)

Department of Fisheries and Oceans Canada

Division for Ocean Affairs and the Law of the Sea (DOALOS)

European Centre for Medium-Range Weather Forecasts (ECMWF)

European Marine Board

European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)

European Space Agency

European Union

Government of Canada

Government of Republic of Türkiye

Government of Denmark

Intergovernmental Oceanographic Commission (IOC)

Intergovernmental Panel on Climate Change (IPCC)

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

International Seabed Authority (ISA)

International Union for Conservation of Nature (IUCN)

National Oceanic and Atmospheric Administration (NOAA)

NATO Centre for Maritime Research and Experimentation (CMRE)

Natural Resources Canada

Nippon Foundation

Taiwan Delegation

United Nations

Worldwide Fund for Nature (WWF)

INTERNATIONAL RESEARCH & ACADEMIC ORGANISATIONS

All-Atlantic Ocean Research and Innovation Alliance

Argo Global Ocean Observing Programme

Atlantic International Research Centre

European Marine Biological Resource Centre

European Research Vessel Operators

GEOMAR Helmholtz Centre for Ocean Research

Global Sea Level Observing System

Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER)

Integrated Carbon Observation System

NEMO (Nucleus for the European Modelling of the Ocean) Consortium

Ocean Facilities Exchange Group

Partnership for Observation of the Global Ocean (POGO)

SeaDataNet

United Nations Decade of Ocean Science for Sustainable Development (Ocean Decade)

University of Miami

University of the Philippines Diliman

Source: SQW based on consultations with NOC staff

STRATEGIC POSITION AND ROLE

NOC occupies a unique strategic position in the UK science and innovation landscape. Key dimensions of this position include:

- **NOC delivers world-class research and technology development across the full spectrum of marine science.** It combines fundamental ocean science, applied research, technology development, data generation, modelling and long-term observation, to address complex marine challenges. This breadth is important because many ocean-related challenges require integrated scientific and technical capability rather than single-discipline responses.
- **NOC leads NERC-funded national marine capability.** In this role, working with its delivery partners (Plymouth Marine Laboratory, the Marine Biological Association and the Scottish Association for Marine Science), NOC manages nationally significant research infrastructure, including two global class research ships, a fleet of autonomous vehicles, the National Marine Equipment Pool, sustained observing programmes and specialist facilities.
- **NOC plays an important role at the interface of marine science and policy.** NOC works extensively with UK Government departments and other public bodies (e.g. the Met Office, Environment Agency, Cefas). This includes providing scientific evidence, expertise and advice to inform policy development, implementation and strategic planning and risk management.
- **NOC plays a strategic leadership and convening role across the UK marine science community,** leveraging both its research activity and national capability. This includes hosting Marine Science UK (see below), serving as a facilitator of grant funding for other research institutions through leadership of strategic research programmes and national capability funds, and leading and participating in national partnership networks including the NOC Association of Marine Science National Capability Beneficiaries (NOCA), which was established in 2010, and brings together the UK's marine science community on an annual basis, to discuss key topics, most recently around national marine capability.

IMPACT SPOTLIGHT
MARINE SCIENCE UK

MARINE SCIENCE UNITED KINGDOM

NOC hosts and leads Marine Science UK, providing the secretariat and chairing the organisation. This brings together 20 organisations from across the marine science community, including research organisations, government agencies and operational organisations. Marine Science UK provides a mechanism for coordination across the marine science sector. Marine Science UK is a key example of NOC's leadership and convening role, enabling member organisations to provide a more coordinated voice for marine science, and communicate robust and coherent marine science evidence to government, industry and the wider community.

- **NOC plays an important role internationally.** NOC is one of a handful of ocean science institutes worldwide with the expertise and infrastructure to operate internationally at scale. NOC is one of the European 'G3' marine institutes – alongside the French Research Institute for Exploitation of the Sea (IFREMER) and Helmholtz Centre for Ocean Research Kiel (GEOMAR) – and participates in major international scientific collaborations, observing systems and ocean research programmes. This includes contributing to international frameworks such as the Global Ocean Observing System (GOOS).

NOC also represents UK interests through organisations such as the Intergovernmental Oceanographic Commission (IOC) and maintains strategic partnerships with international organisations and research agencies, including the National Oceanic and Atmospheric Administration (NOAA) in the United States and peer research institutes across Europe.

- **NOC is a core component of the research and innovation systems in the Southampton and Liverpool city regions.** Both city regions have long-standing expertise in marine science and innovation, and marine industries supporting local employment and economic development. Increasingly, NOC has sought to enhance its networks and relationships in local areas, through engagement with stakeholders, MPs, local authorities and regional partners. NOC's co-location with the University of Southampton and University of Liverpool provides opportunities for research collaboration and contribution to teaching activities at both institutions.

PERSPECTIVES ON NOC'S DISTINCTIVE ROLE AND FEATURES

Framed by this purpose, profile and strategic position, consultations for the impact study sought perspectives from NOC staff and stakeholders on distinctive features of NOC that enable it to generate positive impact for local and national economies.

NOC's combination of roles as both a leading research and technology organisation and provider of national capability for the UK marine science community was the consistent message. NOC's concentration of scientific, engineering, technical and operational expertise is unmatched in the UK. Four interrelated features underpin this position:

- **SCALE AND REACH.** NOC is the largest concentration of marine science, technology and research operations in the UK, providing the critical mass to deliver activities beyond the capacity of other organisations. This enables global reach, with both international partnerships and operational capabilities spanning coastal environments to the deep sea, a scope unrivalled elsewhere in the UK.

> ***"Fundamentally size is key, and with size comes breadth and depth of expertise"***
>
> External consultee

- **LONG-TERM CAPACITY AND OUTLOOK.** Consultees highlighted NOC's capacity to maintain scientific, engineering and observational activity over decades, particularly when addressing challenges such as climate change, biodiversity loss and ocean change, where a long-term perspective is key. The embedded knowledge, technical capability, workflows, processes, networks and relationships that underpin this continuity are crucial, enabling NOC to respond to complex challenges and offer solutions grounded in decades-long experience.
- **INTEGRATION.** The co-location of scientists, data and digital specialists, engineers, and research operations experts is a core element of the NOC model. This enables NOC to connect scientific discovery, technology development and real-world application, which was viewed as particularly important given the complexity and interdisciplinary nature of NOC's missions.
- **CREDIBILITY.** Consultees consistently described NOC as a trusted and independent source of evidence, highlighting strong relationships with government and government agencies, including when representing the UK. A recurring theme was that NOC is trusted because of its scientific integrity and ability to provide impartial, evidence-based advice. NOC's public affairs and policy engagement capability was also viewed as important in strengthening links between scientific expertise and decision makers.

ROUTES TO IMPACT FRAMEWORK



Bringing ocean science to life for adults and children during a glider demonstration at our Southampton Open Day

NOC realises socio-economic impact through a range of mechanisms, reflecting the breadth and diversity of its research, innovation and strategic activities, and scope of its missions. An impact framework developed for this study, which sets out NOC's routes to socio-economic impact, is presented in Figure 3-1.

This framework provides a depiction of the 'theory of change' for how NOC realises socio-economic impact and the scope and nature of these impacts, as evidenced through the study.

The framework sets out the relationship between:

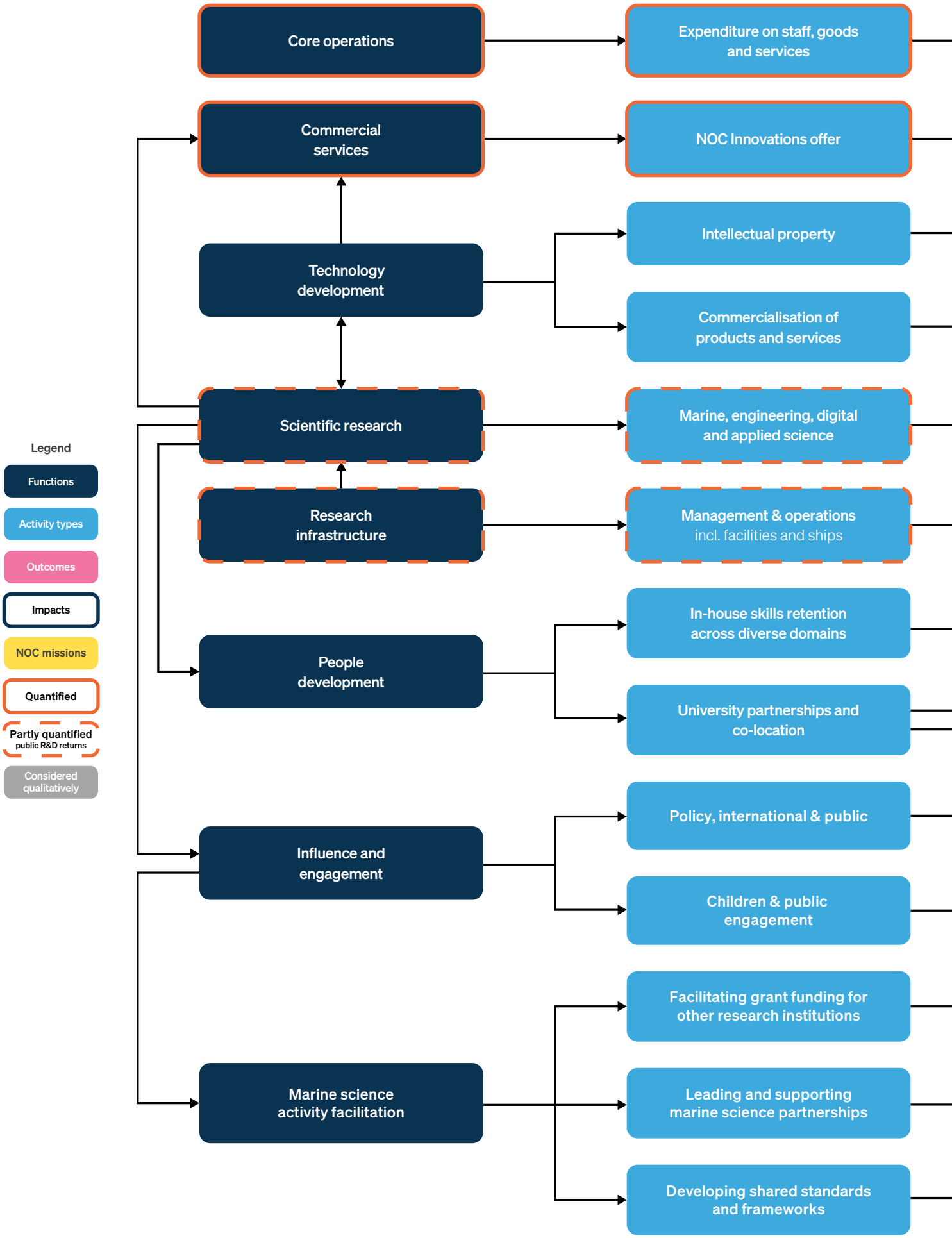
- the functions undertaken at NOC
- the activity areas that sit within these functions
- the types of outcomes that these activities generate
- the subsequent categories of impacts that flow from this, including alignment to delivery against NOC's four missions.

The functions and activities are highly integrated, with key high-level connections highlighted in the impact framework. In practice many more connections are evident, for example, between the commercial services offered via NOC Innovations and improved data/knowledge and enabling research for the UK and international marine science research base. This reflects both the non-linear and iterative nature of research and innovation and the scale and scope of NOC. The impact framework should therefore be viewed as a schematic depiction of the overall key pathways to impact, not as a description of how NOC operates in practice as an organisation, or the pathways for individual projects or activities.

The impact framework sets out what has been quantified to derive estimates of Gross Value Added (GVA) and employment effects[4], and what has been considered via qualitative evidence including in-depth case examples. The qualitative approach reflects the diverse scope of NOC's activities in delivering against its missions, and the nature of the anticipated outcomes and impacts from these activities, which cannot be robustly and adequately captured by quantitative estimates.

Where impacts have been quantified, this relates to impact for the UK, including at a Hampshire and Solent Combined County Authority (HSCCA) and Liverpool City Region Combined Authority (LCRCA) level (for impacts from commercial services and core operations). International impacts are considered qualitatively, including via case examples.

4 *Quantified in gross terms i.e. the GVA and employment estimated results do not include assumptions for dead weight, displacement and substitution.*


Core operations
Expenditure on staff, goods and services
Commercial services
NOC Innovations offer
Technology development
Intellectual property
Commercialisation of products and services
Scientific research
Marine, engineering, digital and applied science
Research infrastructure
Management & operations incl. facilities and ships
People development
In-house skills retention across diverse domains
University partnerships and co-location
Influence and engagement
Policy, international & public
Children & public engagement
Marine science activity facilitation
Facilitating grant funding for other research institutions
Leading and supporting marine science partnerships
Developing shared standards and frameworks
Legend
Functions
Activity types
Outcomes
Impacts
NOC missions
Quantified
Partly quantified
public R&D returns
Considered qualitatively

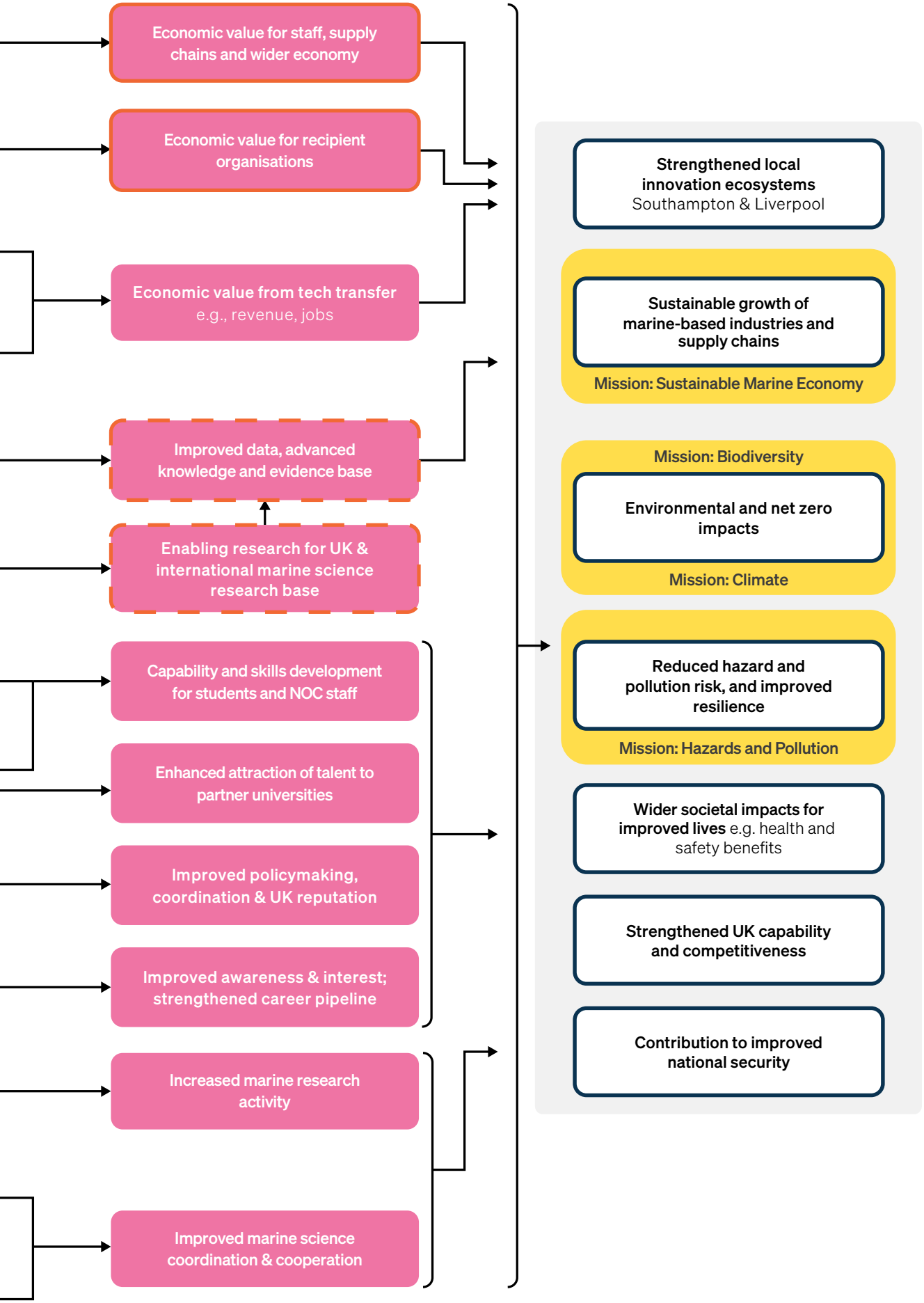


Figure 3-1: Impact framework
Source: SQW

IMPACTS OF NOC'S RESEARCH, INNOVATION AND STRATEGIC ACTIVITIES:

IMPACT CASE EXAMPLES



A member of the RRS Discovery crew, servicing a Met Office weather buoy in West of Brittany in the Bay of Biscay

CONTEXT AND APPROACH

Capturing how NOC's activity is translated into economic and societal impact is challenging. This reflects in part the inherent characteristics of research impact: research is disseminated through open publications and other mechanisms (formal and informal), meaning knowledge uptake and application cannot always be readily identified; where knowledge flows can be tracked, there are long timescales and complex pathways to impact on commercial, societal, environmental or policy decisions; and knowledge from multiple sources is combined to progress new technologies, innovations or changes in practice, making attribution complex.

NOC has characteristics that reinforce this challenge: its scientific activity is broad in scope and inter-disciplinary, impacting a wide range of actors, sectors, and environmental challenges, in the UK and internationally; pathways to impact are highly specific and context-dependent, influenced by different partners, technology maturity, and the operating environment; and many of the issues addressed cannot be robustly or adequately quantified or monetised, including where they relate to the protection of the ocean, avoidance of future adverse outcomes, and the value of fundamental knowledge, understanding and data. Further, NOC tackles long-term and complex issues, with non-linear and emergent outcomes.

Reflecting this context, a case-based approach is important to draw out the nuance and detail of NOC's impacts. Five areas were agreed with NOC that reflect the scope and breadth of its activity and the pathways to impact in the impact framework. The five case examples are:

- **Blue Ocean Research Alliance (BORA)**, a partnership with Subsea7, a global offshore energy services company, to integrate scientific observation into offshore operations.
- **NOC's research on coastal resilience** to provide insight into the evolving nature of the UK's coastlines to inform policy, planning and mitigation measures.
- **NOC's research on subsea cables** to assess the risk from hazards, environmental impacts, and the opportunities to monitor the ocean environment through cable sensing.
- **NOC's research on deep-sea mining** to provide evidence supporting decisions on the potential exploitation of deep-ocean mineral resources while safeguarding ecosystems.
- NOC's role supporting the UK's response to the **Biodiversity Beyond National Jurisdiction Agreement (BBNJ)**, including scientific, technical and operational expertise.

High-level summaries of the five case examples are presented in this section, focused on the key impacts identified. Full case example write-ups are attached in a separate Annex.

The case examples are presented individually, but there are important links between them. For example, NOC's expertise

and knowledge related to deep-sea mining and coastal resilience contributed to its work on the BBNJ. This highlights the reinforcing and integrated pathways to impact. The case examples also demonstrate both the significance of NOC's impacts, and the complex environments and systems within which this impact is realised, including where NOC informs and collaborates with partners to realise ultimate impact.

In this context, the evidence generated through the case examples mapped to functions and impacts is summarised in Table 4-1[5].

Table 4-1: Coverage of impact case examples

	1: BORA	2: Coastal resilience	3: Subsea cables	4: Deep-sea mining	5: BBNJ
Function relevance, reflecting the nature and scope of activity undertaken by NOC					
Scientific research	● ● ●	● ● ●	● ● ●	● ● ●	● ○ ○
Research infrastructure		● ● ○	● ● ○	● ● ○	
Commercial services		● ● ○	● ● ○		
Technology development	● ● ○	● ● ○	● ● ○		
People development	● ○ ○	● ○ ○		● ● ○	
Influence and engagement	● ● ○	● ○ ○	● ○ ○	● ● ○	● ● ●
Marine science facilitation	● ○ ○	● ○ ○	● ○ ○	● ○ ○	● ● ○
Impacts demonstrated, either realised or credibly expected to be realised in the future					
Sustainable growth of marine-based industries	▲ △ △	▲ △ △		▲ ▲ △	
Environmental and net zero impacts	▲ ▲ △	▲ ▲ △	▲ ▲ △	▲ ▲ ▲	▲ △ △
Reduced hazard, risk, improved resilience	▲ △ △	▲ ▲ △	▲ ▲ ▲	▲ ▲ △	
Wider societal impact	▲ ▲ ▲	▲ ▲ △	▲ ▲ △	▲ ▲ △	▲ ▲ △
Strengthened UK capability and competitiveness	▲ △ △	▲ ▲ ▲	▲ ▲ △		▲ ▲ ▲
Key					
Functions:	● ● ● = main		● ● ○ = complementary		● ○ ○ = supporting/enabling
Impacts:	▲ ▲ ▲ = strong		▲ ▲ △ = moderate		▲ △ △ = modest

Source: SQW based on case example research

5 *Case examples did not consider operational or commercial functions or local innovation ecosystems.*

IMPACT CASE STUDY

BLUE OCEAN RESEARCH ALLIANCE® BORA

BORA transforms industrial offshore operations into platforms for ocean science, providing evidence that would otherwise be too difficult or costly to obtain. This has enabled marine science to operate at greater scale, and generate new insights to support marine conservation, infrastructure resilience, and coastal communities.

Offshore industries operate vessels, remotely operated vehicles and other infrastructure continuously across large areas of the world's ocean. This provides a major opportunity to leverage industrial operations to advance understanding of the ocean at scale.

BORA was established in 2021 to integrate NOC-led scientific observation into the routine operations of Subsea7, a global offshore energy services company. The alliance has enabled the collection of scientific data that would otherwise be unavailable or prohibitively difficult to obtain, including in new locations and operational environments.

BORA has successfully demonstrated a new model for marine science. The alliance has leveraged over £2m of industry investment, and generated practical learning on how scientific and commercial partners can work together, a key priority of the international marine science community. Reflecting this, BORA was one of the first science-industry partnerships to receive endorsement by the UN Decade of Ocean Science for Sustainable Development.

> ***"That's what the BORA projects are supposed to be: they're win-win for everybody, as well as local communities, as well as the science, as well as industry."***
>
> External consultee

BORA's observations and research projects have generated new understanding to help address environmental, economic and societal challenges. For example, generating evidence on:

- the distribution and abundance of deep-sea species to inform conservation and ecosystem management efforts
- the damage caused by sediment flows to subsea infrastructure, to improve the resilience of future offshore infrastructure and help avoid associated economic costs
- endangered grey triggerfish populations in Brazil to inform restoration efforts, with potential benefits for fishing communities that depend on the species

Further, BORA has enhanced the robustness and reliability of NOC's 'lab-on-chip' sensor technology, via exposure to industrial environments not normally available to science. This has created wider value as the technology is licensed by NOC to a commercial provider supplying sensors to government agencies, utility companies and research organisations.

BORA has also supported the talent pipeline and next generation of marine scientists. This includes providing data for postgraduate research at the University of Southampton and opportunities for early-career researchers at NOC to lead demonstrator and proof-of-concept projects, building UK scientific capability in research project leadership. Subsea7 staff have also actively contributed to research, improving ocean literacy among people working at sea.

IMPACT CASE STUDY

COASTAL RESILIENCE

NOC's research, data and technologies have improved how coastal risks are understood and managed. NOC has contributed to greater resilience to coastal hazards, increased confidence in mitigation decisions, and lower costs and resource requirements for monitoring, helping protect coastal communities, infrastructure and ecosystems.

Climate change, including rising temperatures, changing weather and higher sea levels, is increasing the risk of flooding, storm surges, coastal erosion, and sandbank movement across the UK. With 6.1m people living in flood-prone areas, and critical infrastructure in coastal areas including railway lines, power stations and water treatment facilities, the consequences of these risks extend beyond physical damage, to public safety, economic performance, and transport connectivity, alongside habitats and coastal ecosystem health. NOC provides intelligence, technology and expertise to inform and support practical action in response.

NOC's work has contributed to increased coastal resilience by generating and strengthening the evidence used to anticipate and respond to coastal hazards. Partnerships are important, translating NOC's scientific, operational and technology expertise into action. For example:

- NOC operates underwater gliders for the Met Office, collecting water temperature measurements across the North Sea. This feeds into the Met Office's weather forecasting models which are used to predict storm surges and flooding, which in turn are used to inform public announcements and decision-making (e.g. managing transport networks)
- The Environment Agency uses this and other NOC-generated data to improve the accuracy of water level predictions, and inform flood barrier closures, including the Thames Barrier that protects over 1.4m people, £320bn of residential property, and 300km of major roads

> ***"The cost savings from the storm surge work are in the billions in non-flooded London."***
>
> Internal consultee

NOC's work has increased confidence in the execution of coastal hazard mitigation activities, enabling efficient infrastructure design and avoiding unnecessary expenditure. For example, NOC's radar monitoring and intertidal mapping technologies were used to avoid costly mitigation measures associated with addressing sediment accumulation at the Manchester Ship Canal. Similar instances have occurred at Morecambe Bay and the Mersey Estuary.

NOC has also contributed to cost savings in coastal resilience. NOC monitoring and observation activities are deployed across multiple regional settings, avoiding the need for costly and bespoke solutions. For example, NOC's radar technology continuously monitors the UK's coastlines, providing reliable and comprehensive data on a day-to-day basis. In contrast, drone-based ocean modelling is expensive, and captures only a snapshot of ocean dynamics.

NOC work on coastal resilience has strengthened the evidence base, communicating emerging coastal risks and informing national and international research and policy agendas. This includes contributing to the UK Climate Change Risk Assessment, The Met Office's State of the UK Climate reports, and informing local coastal resilience strategies, for example in Falkirk where its work led to policy change, with salt marsh restoration added as a policy option.

IMPACT CASE STUDY

SUBSEA CABLES

NOC's research has helped partners to make better-informed decisions and enhanced understanding on subsea cables including where they are laid, how they are protected and how they are managed, both in the UK and internationally. This work supports economic resilience and helps identify opportunities to strengthen national security.

Subsea cables are crucial to UK economic resilience and security: Government estimates that £1.4 trillion of daily UK transactions are reliant on subsea cables, which are responsible for over 90% of UK international data traffic. The mitigation of disruption to subsea cables is critical, with risks including damage to cables from both geohazards (e.g. underwater volcanoes and landslides), and human-made hazards (e.g. harmful fishing practices).

NOC conducts scientific research, develops technology, and provides data and expert advice to manage these risks, and enhance wider understanding on the environmental impact of subsea cables. NOC also works to progress opportunities from subsea cables, including sensing technology that can use cables to generate valuable data to improve future scenario modelling, enhance environmental monitoring, and contribute to national security.

NOC's research on subsea cables has strengthened and informed UK policy and planning. For example, NOC evidence on environmental considerations associated with the decommissioning of subsea cables has been used by the Crown Estate to inform its decisions as a licensing body on whether cables should be recovered or left in situ. NOC research also informed its Marine Delivery Roadmap which is used to direct future cable investment planning.

> ***"To make better informed decisions on [cable] routing, it is vitally important to understand how they exist in the marine environment"***
>
> External consultee

NOC has also contributed evidence to support UK economic resilience and preparedness, which are key national security imperatives. For example, Parliament's Joint Committee on the National Security Strategy 'First Report of Session 2024-26' which considers the potential advance warning time offered by cable sensing to report military threats, references NOC work assessing ocean monitoring opportunities from fibre optic cables and best practice for seabed spatial planning and promoting resilience of submarine telecommunications cables.

Internationally, NOC's work has helped to avoid costs associated with damage and disruption to cables by redirecting routes away from potential hazards, and supported enhanced resilience for isolated communities. Notably, following the Hunga volcanic eruption that severed Tonga's sole international cable in 2022, NOC worked with local partners to diagnose the faults to the cable and select more resilient routes for repaired cables. NOC also contributed to the evidence base to justify a second international cable, increasing the resilience of telecommunications for Tonga's 100,000 plus inhabitants.

NOC's expertise also informs international policy on subsea cable protection and the marine environment, including through work with bodies represented at the UN and the Convention for the Protection of the Marine Environment of the North-East Atlantic Commission.

IMPACT CASE STUDY

DEEP-SEA MINING

NOC has enhanced the evidence base on the potential environmental impacts of deep-sea mining and informed its international regulation and environmental management, contributing to standards, guidance and environmental assessments. Its work is helping stakeholders make better-informed decisions about whether and how deep-sea mining might proceed, balancing economic opportunity with environmental protection.

The deep ocean contains deposits of minerals used in batteries and other technologies essential to the net zero transition. As demand grows for these minerals, deep-sea mining is increasingly being considered as a potential source. However, mining activities have the potential to cause environmental damage, with consequences for biodiversity, ecosystems, and the industries and communities that rely on healthy marine ecosystems.

NOC undertakes research on the environmental impacts of deep-sea mining, and engages with national government, international agencies, and industry partners to inform policy, decision-making and regulation, ensuring that if deep-sea mining does go forward, its effects can be properly measured, managed, and mitigated.

NOC's research has strengthened understanding of deep-sea biodiversity, ecosystem resilience and the environmental consequences of deep-sea mining. This has covered a wide range of research from biodiversity surveys and baseline assessments on species distributions and environmental variability, to field expeditions and monitoring to assess change after disturbance from earlier experimental mining activities.

This evidence has been used to inform policy, regulatory and environmental management impact. NOC has regularly provided scientific evidence and expertise to UK Government, supporting its role as a 'sponsoring state' for deep-sea mining exploration contracts.

> ***"It's really important to ensure that … environmental regulations and standards are prepared with the best scientific information available. "***
>
> External consultee

Internationally, NOC expertise contributed to draft standards and guidelines for baseline data collection, an important technical component of the Mining Code being developed by the International Seabed Authority (ISA), which regulates mineral-related activities on the seabed beyond national jurisdiction. NOC staff have served on the ISA's Legal and Technical Commission, including supporting the development of environmental threshold values to inform regulatory approaches.

Through its work on deep-sea mining, NOC has delivered wider scientific advances. This has included identifying and describing species previously unknown to science, including a new species of hard coral and 24 new amphipod species. Publications and open data – including from research collaborations with industry on environmental baselines, marine spatial planning and monitoring – have ensured that enhanced evidence and understanding is available to the wider scientific community, extending impact beyond individual research projects and NOC's contributions to regulatory and policy development.

IMPACT CASE STUDY

BIODIVERSITY BEYOND NATIONAL JURISDICTION AGREEMENT BBNJ

NOC helped shape the UK's approach to an international agreement intended to protect marine biodiversity across nearly two-thirds of the ocean. Its involvement gave the UK access to practical scientific expertise during negotiations and helped avoid implementation requirements that could hinder marine research. NOC also strengthened coordination and enhanced the UK's readiness for implementation.

The Biodiversity Beyond National Jurisdiction (BBNJ) Agreement establishes a framework for the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction i.e. those parts of the ocean that lie beyond the maritime zones of any country or territory. The Agreement was adopted by the UN and signed by the UK in September 2023.

During formal negotiations from September 2018 to June 2023, NOC was the sole non-government representative in the UK delegation: attending weekly discussions with UK Government officials, supporting the development of UK negotiating positions, and participating directly in negotiations, including on capacity-building and technology-transfer.

Through this period, NOC materially informed UK negotiating positions on the BBNJ. Case example consultees reported that aspects of the UK approach developed with NOC were subsequently reflected in the final Agreement. This was reported to have generated science-diplomacy benefits. NOC's contribution in this process has been formally recognised by the UK Government.

> ***"Organisations such as the National Oceanography Centre ... have provided invaluable support to the UK delegation."***
>
> Parliamentary Under-Secretary of State
> Hansard, 16 October 2025

NOC then helped Government to translate the Agreement into requirements to ensure its passage into UK law and implementation in practice by the marine science community. This included reviewing and commenting on draft versions of the domestic Bill. This helped to ensure that implementation plans reflected the scientific and operational realities of marine research and were workable and proportionate, reducing the risk of unintended disruption to ocean science as a result of the Agreement.

In parallel, NOC strengthened coordination and readiness for implementation across the UK marine science community. NOC helped organisations understand requirements and prepare for implementation by: convening meetings between key actors to discuss draft legislation; publishing papers on implementation challenges (including in collaboration with the Natural History Museum); and summarising the Agreement (on behalf of NERC).

Following its passage into UK law in early-2026, implementation of the BBNJ remains at an early stage. Expected long-term impacts include the better protection of marine areas, strengthened environmental impact assessments, more equitable participation in marine science, and improved sharing of benefits from marine genetic resources. NOC has already developed scientific approaches for area-based management tools and environmental impact assessments. NOC has also continued to shape international implementation through the UN Preparatory Commission, including work on the Clearing-House Mechanism (to facilitate information and data sharing) and preparations for the first Conference of the Parties.

IMPACTS OF NOC'S RESEARCH, INNOVATION AND STRATEGIC ACTIVITIES:

WIDER PERSPECTIVES



An ocean sediment core being scanned at BOSCORF, where specialist facilities support the wider research community

The impact case examples provide in-depth insight into pathways from NOC's activities, demonstrating the way in which the centre generates positive impact across its missions. Other evidence on the wider impacts of NOC's research, innovation and strategic activity, including both established and emerging impact pathways, are considered in this section.

ESTABLISHED IMPACT PATHWAYS

KNOWLEDGE GENERATION AND DISSEMINATION

Knowledge generation and dissemination is core to NOC's impact in the UK and internationally, realised through both direct research undertaken by NOC, and enabling research across the wider marine science community.

The scale and breadth of NOC's own scientific activities is significant. Its research spans both time-limited curiosity-driven and applied research, and long-term research programmes including sustained observations, which provide crucial evidence for understanding environmental and climate risks. Indicating the scale of research activity, NOC scientists contributed to over 4,000 research outputs over 2021-2025. This included over 2,000 articles in peer-reviewed publications, 45 book chapters and 10 books, and approximately 200 datasets/software outputs.[6]

Consultation evidence highlighted several areas where NOC's research was seen to have made an important contribution to the knowledge base over the impact period. These areas included: ocean and climate modelling; ocean-data inputs supporting weather and climate forecasting; coastal flooding, sea-level rise and extreme storms; marine biodiversity and ecosystem change; microplastic pollution; blue carbon and nature-based solutions (see impact spotlight); carbon capture and storage monitoring solutions; species discovery; and the environmental implications of offshore wind, tidal energy and other marine activities.

Citations data provide insight on the contribution of NOC's research to the knowledge and evidence base, indicating where its research is used by others to inform research and scientific advances. OpenAlex indicates that the 4,000+ outputs NOC co-authored over 2021-2025 had been cited over 45,000 times in other publications (at September 2026), and over 700 were identified as among the 10% most cited works globally for its publication year, research field and publication type (based on OpenAlex's field-normalised citation percentile).

6 *SQW analysis of OpenAlex data for the 2021-2025 period.*

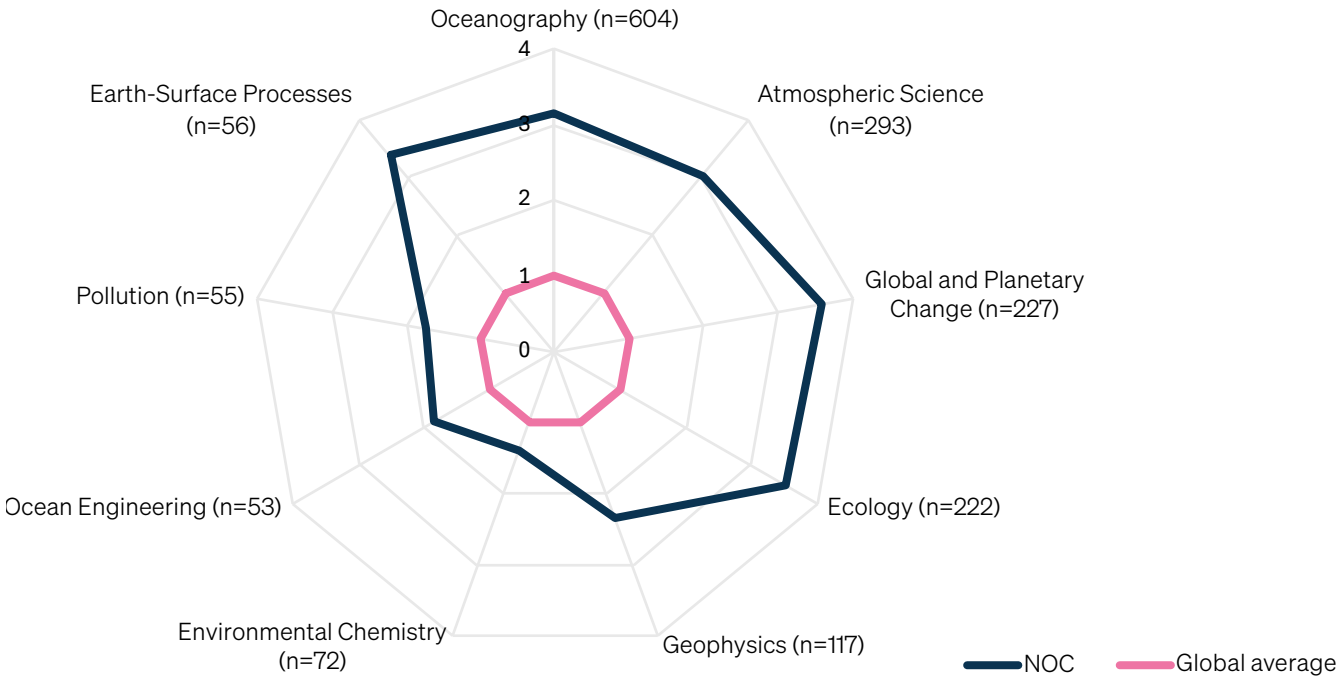
IMPACT SPOTLIGHT

ADVANCING KNOWLEDGE ON BLUE CARBON

Ocean ecosystems such as seagrass meadows, saltmarshes and mangroves capture and store carbon, helping to mitigate climate change, while also supporting biodiversity, sustaining fisheries, reducing coastal erosion and strengthening resilience to storms and sea-level rise. NOC has generated some of the most comprehensive evidence to date on the extent, value and restoration potential of these ecosystems, including a landmark assessment of UK seagrass carbon stocks, and a UK-wide blue carbon inventory. By developing large-scale blue carbon datasets, inventories, models, natural capital assessments and decision-support tools, NOC has helped policy actors and industry identify where restoration and protection can deliver the greatest environmental and societal benefits. For example, NOC's evidence was used by the Government of Belize to develop its national climate commitments through its Nationally Determined Contribution (NDC), and in partnership with Xodus, a multinational engineering and energy consultancy, NOC demonstrated the carbon sequestration potential of a 6,500-acre coastal site in Brazil, supporting the development of credible blue carbon projects and carbon offsetting opportunities.

Further, in NOC's core areas, the Field-Weighted Citation Impact (FWCI)[7] of NOC publications indicates higher levels of citation than expected in the relevant field. For example, with a FWCI of 3.15, the 600+ peer-reviewed publications that NOC co-authored over 2021-2025 in 'Oceanography' were cited more than three times as often, on average, as all other similar publications globally. This demonstrates both the reach and the quality of NOC's research and its impact on international ocean science.

Figure 5-1: Field-Weighted Citation Impact of NOC publications (min 50 publications)



Source: SQW analysis of OpenAlex data

7 *FWCI indicates how the number of citations received by a publication compares with the average number of citations received by all other similar publications in the data universe. A FWCI of 1.00 indicates that the publication has been cited exactly as would be expected based on the global average for similar publications; a FWCI of more than 1.00 indicates the publication has been cited more than would be expected based on the global average for similar publications.*

The research outputs also demonstrate the scope of NOC's research collaboration. Over 200 institutions were identified as co-authors on at least 30 NOC research outputs. The most common co-author institution was the University of Southampton, identified as co-author on around 40% of NOC outputs. Other common co-authors in the UK included the Met Office, University of East Anglia, British Antarctic Survey, University of Liverpool and Plymouth Marine Laboratory. Common international co-authors included **Centre national de la recherche scientifique (CNRS)**, Institut de recherche pour le développement (IRD) and IFREMER in France, Woods Hole Oceanographic Institution and Scripps Institution of Oceanography in the USA, and GEOMAR in Germany. The data demonstrate NOC's important contribution to global science, supporting the UK's role in the international scientific and research community and as a destination for researchers, investment and collaboration.

Alongside its role in delivering research directly, feedback from consultees, both at NOC and externally, consistently identified that **enabling the generation, sharing and application of knowledge across the wider marine science system is key to NOC's impact**. This reflects its role providing national capability and its research infrastructure and specialist facilities.

NOC realises this enabling impact through generating, curating, and sharing data from sustained observations (through licensing, open data, publications), providing access to external researchers to specialist facilities and data infrastructure (see spotlight below), operating NERC's research ships which support research expeditions globally involving researchers from UK and international organisations, and developing and supporting the operation of autonomous underwater systems and other data collection and monitoring equipment.

IMPACT SPOTLIGHT

BRITISH OCEANOGRAPHIC DATA CENTRE (BODC)

BODC is the UK's national facility for managing and distributing marine environmental data. Hosted by NOC in Liverpool and Southampton, BODC provides researchers, government agencies and other bodies with open and efficient access to marine datasets and archives, training and data management services. BODC ensures marine data and information are used efficiently, distributed widely and preserved for future use.

The coverage of the data in the BODC is significant. A key example cited in consultations for the impact study is the NERC Vocabulary Server, which works on controlled vocabularies, semantics and interoperability to provide uniquely identified lists of terms for marine vocabulary services and Earth science data annotation. The BODC is one of only a handful of centres globally providing marine vocabulary services, and the only organisation with such influence in Europe. The Server received 32.5m 'calls' from 306,000 unique visitors in 2024/25 alone. This service enables data collected from different countries, organisations and programmes to be combined and understood consistently. By ensuring publicly funded marine data remain understandable, this facilitates comparison between datasets and timeframes. Consequently, researchers, governments and international bodies can draw upon quality evidence to make informed decisions to manage and respond to changes in climate, biodiversity and ocean conditions.

STRENGTHENING AND INFORMING DECISIONS AND ACTION ON OCEAN, CLIMATE AND COASTAL RESILIENCE

NOC strengthens and informs policy, planning and operational decisions and actions about the ocean by governments, public agencies and other stakeholders. Impact study consultees consistently emphasised the applied nature of much of NOC's research, highlighting its focus on generating evidence, tools, and observations that are used to address real-world challenges and support environmental protection.

In the UK, NOC's research and observational capabilities have supported decision-making across a wide range of contexts and issues, including in relation to climate adaptation, coastal resilience and sustainable marine development. Key examples cited by consultees include:

- Shaping regulations relating to environmental monitoring and impact base-lining through support to the Scottish Government to understand the observing requirements associated with a major expansion of marine renewables
- Improved planning for coastal resilience and managing flood risk by providing sea-level data and specialist expertise to the Environment Agency and maintaining the UK tide gauge network, used in storm surge warning systems and coastal flooding forecasts
- Improved sharing and application of marine data, ensuring government bodies including Defra, Cefas and other marine agencies have access to the high-quality marine evidence needed to support policy decision-making. Mechanisms include leadership of the Marine Environmental Data and Information Network (MEDIN), a UK-wide partnership established to improve the sharing and use of marine data.
- Informing climate adaptation and resilience planning by UK public bodies, with NOC's long-term environmental observations contributing to the evidence base used within the UK Climate Change Risk Assessment process.
- Improving the accuracy of weather forecasting, including through extensive engagement with the Met Office (see spotlight below)

IMPACT SPOTLIGHT

INFORMING THE MET OFFICE'S WEATHER FORECASTS

NOC is a long-term collaborator with the Met Office, the UK's national meteorological service. The Met Office provides weather and climate research and services to the UK public, industry, governmental departments, and other organisations. The economic role of the Met Office is significant, analysis in 2024 estimated that it would deliver £56bn of benefit over the next decade.[8] NOC's work enables the Met Office's forecasting systems to more accurately understand current environmental conditions and better reflect the role of the ocean in climate models. For example, NOC collaborated with the Met Office through the Joint Marine Modelling Programme to develop the Nucleus for European Modelling of the Ocean (NEMO), a state-of-the-art ocean modelling framework. Further, NOC manages autonomous ocean floats which provide near real-time temperature, salinity and pressure data from the Argo Programme for ocean forecasting in near real-time to feed into the Met Office's forecasting systems. This work improves the accuracy and reliability of weather forecasts and advance warnings of extreme weather, better informing decisions on national climate resilience and preparedness by government, emergency responders, businesses and the public to protect lives and critical infrastructure.

The ability of NOC's research to influence decision-making and action is supported by dedicated policy and international engagement functions that help translate scientific evidence into forms that are accessible and relevant to decision-makers. Since independence, NOC has enhanced these capabilities and continues to contribute to the UK's policy landscape by responding to government consultations, providing evidence to parliamentary inquiries, and engaging with policymakers.

8 *Economic and social research at the Met Office - Met Office - https://www.metoffice.gov.uk/about-us/governance/economics*

NOC is also a member of the Natural Hazards Partnership, providing scientific advice to the UK Government's Cabinet Office on preparation, response and review of natural hazards including flooding, geological hazards, volcanic ash, weather and wildfires.

NOC's impact in this area extends into international climate and ocean governance. NOC contributes to assessments produced by the Intergovernmental Panel on Climate Change (IPCC) which are used by governments worldwide to develop climate policy. NOC also plays a leading role in international observing and research initiatives, including RAPID (see below), the Global Ocean Observing System (GOOS) and the Intergovernmental Oceanographic Commission (IOC), extending the impact of its science to environmental decision-making at a global scale. NOC's contribution to international ocean governance is explored in the case example on Biodiversity Beyond National Jurisdiction Agreement.

IMPACT SPOTLIGHT

TRACKING THE OCEAN CIRCULATION THAT SHAPES THE UK'S CLIMATE

The Atlantic Meridional Overturning Circulation (AMOC), a major ocean circulation system, moves 17 million cubic metres of water and 1.2 petawatts of heat northwards every second. By transporting heat from lower to higher latitudes, it is critical for regulating the climate in Europe, for example by contributing to the relatively mild winters experienced in the UK. Since 2004, NOC has led RAPID, one of only a handful of sustained observing programmes worldwide able to measure the AMOC's strength directly. NOC runs this in partnership with the University of Miami and the US National Oceanic and Atmospheric Administration (NOAA), alongside OSNAP, its companion subpolar observing programme. NOC scientists use this long-term observational record to detect changes in the AMOC and run and test climate models, helping policymakers and stakeholders – including the Met Office – understand what an AMOC slowdown could mean for future climate.[9] RAPID has generated approximately 400 publications since its launch, and 20 since 2021 alone.[10] NOC's recent research has also explored near-real-time retrieval of AMOC observational data via satellite links, with the potential to improve forecasting of extreme climate events and provide earlier warning to support preparedness and response.

SKILLS, CAREERS AND PEOPLE DEVELOPMENT

NOC supports the development of the future marine science and technology workforce. The NOC Student Gateway provides a route for postgraduate students to work with NOC through university partnerships, building on long-standing collaborations with the University of Southampton and the University of Liverpool. Through these relationships, students can access NOC's specialist expertise, facilities, and research equipment. NOC also participates in collaborative Doctoral Training Partnerships, including Adapting to the Challenges of a Changing Environment (ACCE+) Doctoral Landscape Award (DLA), through which doctoral students can access shared and bespoke training at participating institutions, including NOC, the UK Centre for Ecology & Hydrology (UKCEH), the Universities of Sheffield, Liverpool and York, and the Natural History Museum.

NOC was supporting approximately 70 PhD students at the time of the impact study, alongside undergraduate and master's students undertaking projects with NOC. These opportunities support longer-term career development, with students trained

9 *The Atlantic Meridional Overturning Circulation in a changing climate - Met Office - https://www.metoffice.gov.uk/blog/2024/the-atlantic-meridional overturning-circulation-in-a-changing-climate*

10 *RAPID Publications - https://rapid.ac.uk/publications*

at NOC progressing into academia, business and wider research and environmental organisations. Earlier in the skills pipeline, NOC also provides a careers engagement and virtual work-experience programme for young people, with a skills accelerator programme and a focus on widening access to marine science careers.

NOC also upskills the wider research community through training, guidance and capacity-building activities. This includes developing skills in areas such as marine data management. For example, through the Marine Environmental Data and Information Network (MEDIN), NOC delivers training workshops and resources on data-management principles and good practice, and data management training has been embedded within established programmes such as BOSCORF. NOC also contributes to international capacity development; consultees described delivering workshops and technical demonstrations for overseas partners. For example, training collaborators in the Philippines to interpret scientific profiles to derive sediment accumulation rates.

> ***"Training is a key factor, the PhDs that NOC host and funds and the fellowships and also the on-the-job training. There is very significant impact there when those people then go and take up positions in government and in business."***
>
> External consultee

Alongside formal skills and training activities, NOC contributes to wider public understanding of ocean science through a dedicated public engagement team. This activity helps build ocean literacy and raise awareness of the ocean's role in society, climate and environmental change. NOC delivers this through activities including open days, roadshows, museum and science-centre partnerships, and visits to its research ships. For example, NOC's annual open day attracts around 2,000 visitors and involves approximately 160 staff and 30 exhibitors, providing opportunities for the wider public to engage directly with marine science and technology. NOC has a dedicated Learning Hub, including education resources.[11]

The impact study highlighted the importance of the specialist knowledge and expertise held by NOC staff, and the ongoing in-house training required to develop and maintain these capabilities. NOC is recognised as a hub for specialist expertise, with staff combining scientific, technical and operational skills to deliver complex multidisciplinary research expeditions. This extends beyond scientific roles to professional maritime and technical careers. For example, NOC is responsible for the training and professional development of the crews operating its research ships, including approaching 100 seafarers across four crews. NOC's impact here is important in contributing to the wider marine skills base, helping develop and sustain the range of technical and operational skills required by the sector.

NOC's role as an internationally recognised 'breeding ground' for marine science experts was also cited by consultees for the impact study, with 'NOC alumni' found in other marine and climate science organisations across the UK and internationally. As described by one external consultee *'You can go to any major marine institute or university department globally, and there's a very good chance that you'll find somebody who's passed through [NOC] as a student or a member of staff, including at senior levels.'*

ENHANCED COLLABORATION ACROSS THE MARINE SCIENCE COMMUNITY

Consultation evidence highlighted NOC's impact in enhancing collaboration across the marine science community. This is both a national and international contribution, with NOC helping to address coordination gaps across institutions and provide a more cohesive and integrated voice to Government and other decision makers in progressing ocean science priorities and agendas.

11 *See here for details: Learning Hub | National Oceanography Centre - https://www.noc.ac.uk/discover-the-ocean/learning-hub*

A key mechanism here is the provision of shared research infrastructure. The NOC-operated research ships, National Marine Equipment Pool and specialist facilities provide a forum for collaborative research involving universities, research institutes and public sector organisations, both in the UK and internationally. By providing these shared capabilities on behalf of the wider community, NOC helps facilitate collaborative research that could not be delivered by individual institutions, unlocking new partnerships, scientific opportunities and advances in knowledge.

Beyond providing research infrastructure directly, NOC enhances collaboration through a range of other mechanisms. First, through its own research activity, which routinely involves other partners across the UK marine science community, and, where relevant, international partners.

> ***"Almost every proposal that we put in has university partners or partners in other organisations ... it means our influence is felt and benefits other academic establishments."***
>
> Internal consultee

Second, through leading initiatives such as Marine Science UK, and its role in coordinating collaboration between major UK marine science organisations receiving national capability funding.[12] In its role managing national capability funding on behalf of NERC, working in partnership with marine centres across the UK, NOC helps bring together research organisations, government bodies and other stakeholders to share knowledge, identify common priorities and engage collectively on issues affecting the sector. NOC has also coordinated responses from the marine science community to Government consultations and parliamentary inquiries, such as select committee inquiries, with some 45 consultations over 2021-2025 involving NOC led or coordinated responses.[13]

Third, through its national and international partnerships and networks. For example, as a founding member of the Nucleus for European Modelling of the Ocean (NEMO), NOC helped establish a long-standing international partnership that brings together expertise from multiple countries to develop and maintain shared ocean-modelling capabilities used in forecasting and climate prediction systems. NOC also provides the NERC-UKRI representative to the European Marine Board (EMB), a leading European think tank in marine science policy.

EMERGING IMPACT PATHWAYS

CONTRIBUTION TO NATIONAL SECURITY

NOC is increasingly contributing to the UK's national security, and the development of the UK's defence industries, a key sectoral priority identified in the Government's Industrial Strategy.

This contribution is realised in part through NOC's ocean science research which contributes evidence and expert advice to national resilience, including related to critical infrastructure, geohazards, the impacts of climate change on ecosystems and marine environments and critical minerals. This contribution is demonstrated through its work on subsea cables and deep-sea mining, set out in the case example above.

Further, NOC's contribution to national security is realised through targeted engagement with key national security and defence partners on collaborative research, operations and technology development activities. This includes both strategic

12 *Working with Plymouth Marine Laboratory, the Scottish Association for Marine Science and the Marine Biological Association.*

13 *See the list of consultations here: UK Coordination and Support | National Oceanography Centre - https://www.noc.ac.uk/work-with-us/public-affairs/uk-coordination-and-support*

partnerships and scientific advice and operational support to UK military and defence agencies, and applied research and commercial services for defence industries, supporting the delivery of the 2025 Defence Industrial Strategy.

Notably, NOC's expertise in autonomous systems, sensors, and under-ice operations/observations is directly relevant to defence. Consultees for the impact study highlighted that scientific needs for ocean research and defence considerations often coalesce, addressing similar technical and operational challenges.

> ***"Our interests are very similar to the Royal Navy's interests … We need to record similar data and we want similar systems."***
>
> Internal consultee

NOC's work with UK military and defence agencies is facilitated through a memorandum of understanding (MOU) with the Royal Navy, which also includes collaboration with Defence Science and Technology Laboratory (Dstl), the Ministry of Defence (MOD)'s science and technology organisation. A particular focus is leveraging NOC's expertise in developing and operating autonomous underwater vehicles including gliders which are critical to under-ice operations, deep-sea exploration and national security applications. This aligns with the 'Hybrid Navy' concept[14], the transition to a hybrid force of state-of-the-art crewed ships networked with uncrewed surface and undersea craft.

For military and defence agencies, NOC has provided training, technical advisory and operational support on marine autonomy, expert advice on engineering needs for hybrid technology, and undertaken targeted scientific research to inform national security priorities, for example demonstrating the use of maritime autonomy in national defence[15], and working with the Defence Nuclear Organisation and UK Hydrographic Office (both part of MOD). NOC has also worked with military agencies of the UK's allies and international security partnerships.

Applied research and commercial services for the defence industry have also been an increasing focus for NOC. NOC has worked with UK Defence Primes including on sensor technology, technical testing, and technology development. Commercially confidential, the scale of this activity is growing, leveraging NOC's scientific, engineering and operational expertise to support the growth and development of UK (and ally) defence industries.

SUPPORTING LOCAL CLUSTERING AND RESEARCH AND INNOVATION ECOSYSTEMS

NOC's role in defence industries is reflected in the 2025 Defence Industrial Strategy, where it is identified as a key component of a defence and security cluster in Portsmouth and the Solent, alongside Portsmouth Naval Base and Qinetiq's National Maritime Systems Centre[16]. This is an important example of NOC's emerging impact in supporting cluster development and local research and innovation ecosystems, alongside its national contribution.

This is grounded in the combination of skilled people, data, relationships and networks, infrastructure and specialist facilities. Longstanding and extensive strategic partnership-working, research collaboration, and operational engagement with the University of Southampton and University of Liverpool respectively is also core to this local contribution.

The impact is most significant in Southampton, where NOC acts as a key anchor institution in the local innovation ecosystem. This reflects the significant scale of scientific and technical staff, and specialist equipment and research facilities in Southampton,

14 The Defence Investment Plan - https://assets.publishing.service.gov.uk/media/6a44e989167a99cf0018da38/The_Defence_Investment_Plan.pdf

15 https://committees.parliament.uk/writtenevidence/141653/pdf/

16 Defence Industrial Strategy: Making Defence an Engine for Growth - https://assets.publishing.service.gov.uk/media/68bea3fc223d92d088f01d69/Defence_Industrial_Strategy_2025_-_Making_Defence_an_Engine_for_Growth.pdf

attracting both employees and visiting researchers, partners and strategic stakeholders.

The presence of the Innovation Hub is also important. This provides a visible forum for collaborative engagement between research, industry partners and marine science stakeholders in the local area. It also provides a physical location for businesses looking to start-up and scale in the local area, with examples of businesses based at the Hub subsequently moving to other locations in the area to support expansion, whilst retaining networks and research/commercial partnerships with NOC.

> ***"The level of expertise and specialism [at NOC] makes them a global leader. That brings people to the city who would not otherwise be here."***
>
> Internal consultee

NOC is a strategic partner of Maritime Solent, and active in other local partnerships and networks. NOC is explicitly cited in Southampton's Growth and Prosperity Plan as one of the key organisations – along with the city's two universities and the University of Southampton Science Park – in positioning Southampton as a centre for innovation, and driving advances in marine science.[17]

The role of NOC in drawing people to the city was explicitly identified by local consultees as an important component of its local economic contribution, drawing on and complementing its science and innovation offer. In this context, consultees cited NOC hosting major events such as the biennial Ocean Business conference and its own Marine Autonomous Technology Showcase in Southampton as an important part of NOC's contribution to the local marine economy and ecosystem, alongside a wide range of other events and conferences.

IMPACT SPOTLIGHT

HOSTING MAJOR MARINE INNOVATION EVENTS

NOC hosts hundreds of events each year, ranging from specialist workshops and scientific conferences to major international industry events. Collectively, these events attract researchers, businesses, investors, policymakers and technology developers to Southampton and Liverpool, helping to raise the visibility of the local marine clusters and creating opportunities for collaboration, knowledge exchange and commercial engagement. The most prominent examples include Southampton-based events such as Ocean Business and the Marine Autonomous Technology Showcase (MATS). Hosted biennially, Ocean Business is one of the largest ocean technology events in the world and was reported by NOC to have attracted around 6,000 visitors over three days at its most recent edition in 2025. Analysis provided by NOC indicates that the event delivered an estimated £4.2 million boost to the Hampshire economy, driven by spending from overnight visitors and event-related local procurement. MATS provides a complementary forum focused on marine autonomy and emerging technologies, attracting 200-300 specialist attendees from industry, academia and government. Together, these events provide a major platform for showcasing marine technologies and strengthening links between the Southampton marine cluster and wider markets and networks. They also bring visitors to the local area, generating expenditure for businesses including accommodation, food and drink and transport services.[18]

17 *Southampton Growth and Prosperity Plan - https://www.southampton.gov.uk/media/l4hbuq1q/southampton-growth-and-prosperity-plan.pdf*

18 *Data on attendees of events held at NOC across the impact period was not available. These impacts have therefore not been quantified in the impact model.*

In Liverpool, NOC's contribution is more targeted, but distinctive. NOC can be characterised as an increasingly important actor in the LCRCA local innovation ecosystem. NOC's presence in Liverpool retains particular strengths in coastal science, shelf-sea processes and coastal engineering, complementing Southampton's focus on deep-ocean research, vessels and engineering. Consultees highlighted NOC's strong and extensive engagement with the local research base, notably with the University of Liverpool's School of Environmental Sciences, and its role as a participant in local sector partnerships such as Mersey Maritime and regional industry networks. Leveraging NOC's expertise through external engagement in the local area has been a priority locally over the impact period, reflecting the increasing focus on sub-national and place-based innovation systems and economic development.

In both Southampton and Liverpool, an important part of the local contribution is through supporting students and training including via doctoral partnerships, placements and providing students with access to facilities and equipment. NOC was also seen by some consultees as raising the profile of marine science in partner universities, helping to attract students to Southampton and Liverpool respectively, further supporting local economic development and impact.

Supporting local skills development and alignment of NOC's skills activities to sector needs in its local areas was identified as an area of increased focus and priority going forward. This was seen as important to help drive local economic impact, including addressing identified shortages in marine technical skills including engineering and maintenance occupations.

NOC also has a significant economic impact at a local level. This is quantified and considered in more detail in Section 6 (related to commercialisation impacts) and Section 7 (related to operational impacts).

> ***"We are becoming a lot more active in thinking about how our skills pipeline can support local rejuvenation and good jobs for people in the area "***
>
> Internal consultee

ESTIMATING THE ECONOMIC IMPACT OF NOC'S RESEARCH

The evidence above demonstrates the scope and benefits to society of NOC's research. There are inherent and well-recognised challenges in quantifying the value of this activity, including the complex pathways to impact, uncertainty over eventual application, and where improved scientific understanding is not readily expressed in monetary terms. For NOC, this challenge is exacerbated given the broad range of sectors within which innovations arising from its research can be (and have been) applied, and the open-source and enabling nature of many of its activities, including providing facilities, observations, datasets and tools.

However, whilst the individual routes cannot be captured and quantified robustly, evidence on the returns to public investment in R&D on private sector productivity can be used to provide a reasonable and pragmatic estimate of the potential long-term economic benefits to society of this activity. Specifically, Government-published research estimated that on average, public investment in R&D will generate a 40% return in private sector productivity after a period of six years. In practice, this means that annual GVA in the private sector can be expected to be £0.4m higher in six years' time owing to £1.0m of public R&D investment.[19]

This Government-published research has been used to estimate the gross economic impact of NOC's research over the impact period. The productivity uplift estimate has been applied to NOC's £244m income from UKRI. We have modelled the impacts over a 10-year impact realisation period, applying discount rates to the future impacts and adjusting for inflation.

19 *See Returns to Public Research and Development - GOV.UK - https://www.gov.uk/government/publications/returns-to-public-research-and-development*

Applying this approach suggests that **UKRI-funded research activity undertaken by NOC during the impact period could generate an estimated £826-853m in discounted long-term economic benefits** (expressed in 2025 prices) **across the wider UK economy.**[20] These benefits are expected to arise over time as knowledge, technologies and innovations generated through NOC's research are adopted and translated into productivity improvements.

20 The estimated range reflects different discount rate assumptions. At the time of writing, the formal Green Book discount rate was 3.5% per annum. However, the Chancellor of the Exchequer announced in September 2026 the Government's intention to reduce this to 3.0%, see Chancellor John Healey's Growth Speech 2026 - GOV.UK - https://www.gov.uk/government/speeches/chancellor-john-healeys-growth-speech-2026. Estimates have therefore been tested using both rates.

IMPACTS OF NOC'S COMMERCIAL ACTIVITIES



Autosub is now commercially available, bringing our advanced autonomous capabilities to industry

CONTEXT AND APPROACH

Commercial activities are a key mechanism through which NOC's scientific and engineering expertise, and its specialist facilities and knowledge assets, are translated into impact for industry and wider society. Alongside generating income to support the centre's strategic priorities and charitable activities, these commercial activities enable the development of new or improved products, services and processes across the marine economy, leading to positive business outcomes for clients and commercial partners.

NOC's commercial offer spans four broad product and service areas: commercial software and data; marine ecosystem services; analytical services; and engineering services. Specific activities include tidal prediction software products and services, high-resolution ocean modelling and data products, environmental monitoring and blue carbon consultancy, geotechnical and laboratory analysis, and autonomous vehicle-related engineering, testing, training and development services.

Commercialisation involves a mix of mechanisms including direct sales of services and products, technology licensing, contract research and longer-term strategic partnerships to develop and exploit technology opportunities. Licensing is particularly important where it enables technologies developed at NOC to be scaled and manufactured for clients across the marine economy, at a level that NOC could not deliver directly as a research-led organisation (see spotlight below).

NOC's commercial activities are managed through NOC Innovations, a wholly owned trading subsidiary of NOC, focused specifically on translating the centre's world-leading marine science into practical solutions for industry.

IMPACT SPOTLIGHT

LICENSING TECHNOLOGY DEVELOPED AT NOC

NOC uses licensing to translate scientific research and technology development activity into products and services that continue to generate economic and societal benefits over time. In the last five years, NOC Innovations has completed five technology licences, with an estimated value to NOC of over £15m between 2020 and 2035. Four of the five licences have been granted to UK businesses. For example, alongside offering sales and hire of NOC's autonomous underwater vehicles – 'NOC Autosub vehicles' – NOC Innovations entered into a licensing agreement with a company in Southampton to manufacture NOC Autosub for commercial and other users. Licensing was also the commercialisation mechanism for 'lab-on-chip' chemical sensing technologies developed at NOC. This technology applies laboratory chemistry techniques in compact deployable systems that can be used in situ and at full ocean depth. The technology has been licensed to Clearwater Sensors, a Southampton-based company with roots in NOC's research.

How these commercial services will support value generation will vary considerably across different product and service areas, and a diverse customer base. In total, around 350 UK-based organisations purchased commercial services from NOC over the impact period, including around 70 organisations based in the Hampshire and Solent Combined County Authority (HSCCA) and 15 organisations based in the Liverpool City Region Combined Authority (LCRCA). Customers operated across a range of sectors, including maritime services, public services, marine technology and engineering, offshore energy, defence and security, environmental management, finance and insurance, and others. This demonstrates the breadth, scope and reach of NOC's commercial activities across the UK.

Further, NOC's commercial services include a mix of consistent product/service lines available for commercial purchase/hire such as access to tidal prediction software and data, highly bespoke and tailored services aligned to specific customer needs (e.g. specific technical analytical tasks related to specific locations and hazards) and contract research services that leverage the key assets and technical expertise of the centre (see spotlight below).

IMPACT SPOTLIGHT

LEVERAGING SPECIALIST EXPERTISE AND ASSETS

BOSCORF is the UK's largest deep-sea sediment repository and research facility. The facility stores sediment cores collected during research cruises and includes specialist analytical equipment to investigate characteristics such as chemical composition, sediment constituents and microplastics. BOSCORF holds over 2,500 samples, making them available to the global scientific community, and represents a unique sample collection in the UK. NOC has been working actively to commercialise these capabilities for organisations interested in seabed conditions and processes, including organisations in sectors such as renewable energy (e.g. offshore wind) and oil and gas decommissioning, to inform their assessment of potential geological hazards such as underwater landslides. This is an important example of how NOC's scientific expertise and specialist facilities are being used to inform decision-making and investment across marine industries and generate commercial income to support core research activities.

To provide a meaningful estimate of economic impact across this diversity, we have therefore assumed GVA impact on a 1:1 basis to the income generated by NOC i.e. the GVA impact is estimated to be the same as the cost of the purchase (adjusted to real terms). This is underpinned by the assumption that, on average, the return on investment has to be attractive for clients, and in a market, organisations would not purchase the service unless they expected to derive at least this minimum level of value. This provides a proportionate and cautious estimate of the GVA impact of NOC's commercial services[21]. Full methodological detail is provided in a separate Technical Annex accompanying this report.

In modelling economic impact (GVA and jobs), the focus was on benefits for UK clients only. The benefits for international clients are important and should be seen in the context of the broader international contribution of NOC (see discussion below).

21 In practice, further economic effects are likely to occur through supply-chain benefits. However, the scope and nature of these effects is uncertain, and the GVA benefit may be realised in the form of productivity or efficiency gains rather than additional supplier expenditure. The sectoral and spatial make-up of these effects is also unknown. The indirect effects have therefore not been quantified.

QUANTITATIVE IMPACTS OF COMMERCIAL SERVICES

NOC delivered commercial services with an income value of £14.5m over the impact period.22 The scale of commercial services increased materially over the impact period, from an income value of £1.1m in 2021/22 at the start of the period, to £8.3m in 2024/25 by the end of the period. This reflects an increased strategic focus within NOC on translating its research activities to deliver wider impact for industry and society; this has been a particular priority since NOC became an independent organisation in 2019 and remains a key priority for the future. This has involved significant investment in the team supporting commercialisation, which has grown to c. 30 staff today compared to under 10 at the start of the impact period.

The GVA impact of NOC's commercial services is estimated to be approximately £11.0m across the UK over the impact period. This is estimated to have supported 26 jobs on average in the UK economy over this period. However, consistent with the increase in the revenue generated from commercial services, the employment impact is estimated to be substantially higher in the final year of the impact period: by 2024/25, it is estimated that NOC's commercial services supported approximately 60 jobs across the UK.

The estimated GVA and jobs impact of NOC's commercial services is largely realised across the UK as a whole, rather than in the HSCCA and LCRCA areas. This reflects the broad spatial distribution of NOC's clients. It also highlights the centre's contribution to the development of the marine sector, and associated industries, at a national level.

Table 6-1: Estimated GVA impacts of NOC's commercial services (£m, 2025 prices)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025	Total
HSCCA	0.1	0.2	0.3	0.4	0.9
LCRCA	0.0	0.1	0.1	0.2	0.4
Rest of UK	1.2	2.1	1.8	4.6	9.7
Total	**1.2**	**2.4**	**2.2**	**5.2**	**11.0**

Source: SQW analysis of NOC data

Table 6-2: Estimated employment impacts of NOC's commercial services (number of jobs)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025	Average
HSCCA	0	2	2	4	2
LCRCA	0	0	1	3	1
Rest of UK	7	16	15	52	23
Total	**8**	**18**	**18**	**59**	**26**

Source: SQW analysis of NOC and ONS data

22 Approximately three-quarters of the commercial income (£10.6m) was generated from UK-based clients. However, as shown in a separate Technical Annex, significant growth in income from both UK and non-UK sources was realised over the impact period.

WIDER IMPACTS OF COMMERCIAL ACTIVITIES

Alongside the delivery of services directly to industry, the Innovation Hub in Southampton plays a key role in NOC's innovation and commercialisation ecosystem, supporting the growth and development of marine industries and applications. Building on the Marine Robotics Innovation Centre (established in 2017), and enhanced in 2025, the Hub provides physical infrastructure for innovation and enterprise, including workspace and membership for third-party start-ups operating from the NOC site. The Hub has grown over the impact period to around 50 current members, including 30 UK start-ups, providing a route through which NOC can engage smaller firms and support wider innovation activity.

Over the past five years, NOC reported that the Hub has supported the growth of 15 start-ups in the HSCCA area, which have created an estimated 55 jobs in total. These jobs have not been included in our formal impact modelling owing to the complexity of attribution (noting that other factors may have contributed to their growth). However, NOC Innovations' contribution to this employment demonstrates the wider positive impacts of its commercial activities for the marine economy, both in Southampton and nationally.

IMPACT SPOTLIGHT

SUPPORTING THE GROWTH OF MARINE BUSINESSES

Several key examples of how the Innovation Hub/Marine Robotics Innovation Centre has supported business growth were highlighted in the impact study:

- **A firm focused on smart shipping and maritime autonomy software based their HQ at the innovation centre and subsequently grew from 4 to 16 staff. They recently relocated to a new facility in Southampton to support further expansion.**
- **A member firm that provides specialist maritime consultancy and learning solutions used NOC facilities to provide autonomous technology operations training for clients in the UK and internationally, all delivered in the UK. Four new jobs were created to support delivery of training to large corporate businesses in the Middle East.**
- **Research collaboration between NOC's Marine Autonomous & Robotics Systems group and hub members led to the development of EcoSub technology (small autonomous vehicles), now established as an operating division of Planet Ocean Limited.**

Evidence from consultees for this impact study indicated a strong commercialisation pipeline, with around 85 IP opportunities identified that are being considered for protection, licensing, and commercialisation and/or that have the potential to be developed into products, services or spinouts. Several potential spinouts were being actively considered by NOC in mid-2026.

Finally, the international contribution of NOC's commercial activities is notable. Over the impact period, NOC Innovations' clients included more than 140 international organisations, demonstrating global demand for UK ocean science, engineering and autonomous systems capability. Over two-thirds were based in Europe, accounting for over 80% of income.

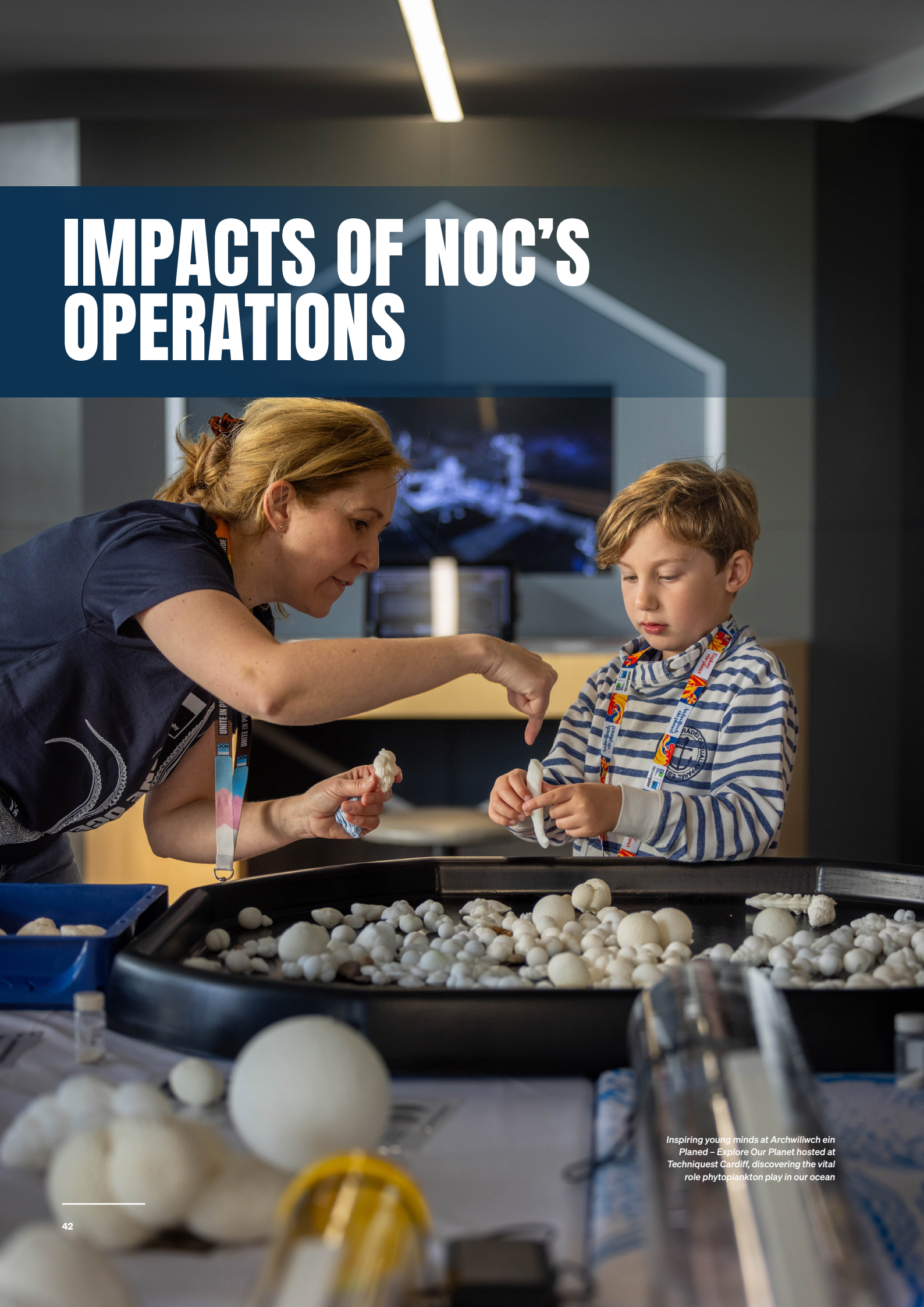
Table 6-3: Location of non-UK clients for commercial services in the impact period

Region	Number of clients	Value of income (£m)
Europe (excluding UK)	100	3.24
North America	17	0.21
Asia	12	0.06
Other	8	0.23
Middle East	7	0.13

Source: SQW analysis based on NOC data

Key examples of commercial services for international clients cited by consultees for the impact study included provision of testing and calibration services to international research institutes, glider servicing and piloting training for overseas defence and marine organisations, and the export of NOC-developed technology to international partners via licensing agreements. These activities generated export income for the UK. They were also reported to have contributed to enhancing the UK's position and reputation as an international leader in ocean technology and innovation.

IMPACTS OF NOC'S OPERATIONS



Inspiring young minds at Archwiliwch ein Planed – Explore Our Planet hosted at Techniquest Cardiff, discovering the vital role phytoplankton play in our ocean

CONTEXT AND APPROACH

This section considers the economic contribution generated through NOC's operations. NOC is a substantial employer of highly skilled research, technical and operations staff based in Southampton and Liverpool, and mariners on the research ships, and operates national research facilities. Through these activities, NOC generates economic value directly through the deployment of its workforce, expertise, facilities and infrastructure, and indirectly through the demand generated for its suppliers and the expenditure of employee income within the wider economy.

To capture these routes to economic impact, the analysis estimated three types of impact:

- **Direct impacts of operations:** the employment supported directly by NOC and the Gross Value Added (GVA) generated through its own activities, capturing the value added created by NOC itself rather than through wider supply-chain or spending effects, or the subsequent application of NOC's research, technology and expertise by others.
- **Impacts of expenditure on goods and services:** the employment and GVA supported through NOC's expenditure on its suppliers. These impacts reflect the economic activity generated as NOC creates turnover for its suppliers and, through supply chain effects, for businesses further down the value chain (i.e. the suppliers of NOC's suppliers).
- **Impacts of staff expenditure:** the employment and GVA supported through the expenditure of NOC's employees. These impacts reflect the economic activity generated as NOC's staff expenditure flows through the economy. Specifically, when staff spend their salaries on personal goods and services, this creates demand for businesses. NOC's payment of National Insurance (NI) and pension contributions also supports economic activity through government spending and pension fund investment, respectively.

Impacts were estimated for the UK as a whole, with separate consideration of impacts within the HSCCA and LCRCA areas. The analysis focused on a four-year period from October 2021 to September 2025, corresponding to NOC's last four financial years (which run from October to September) at the point of the impact analysis. All GVA values are presented in 2025 prices.

Full methodological detail is provided in a separate Technical Annex accompanying this report.

DIRECT IMPACTS OF OPERATIONS

NOC generated an estimated £189.3m of direct GVA over the impact period, equivalent to an average of £47.3m per year in 2025 prices. Annual direct GVA was relatively stable, ranging from £44.3m to £50.3m. Reflecting the distribution of NOC's workforce, the majority of direct GVA was generated in the HSCCA area, which accounted for £150.8m of total direct GVA over the period, compared with £38.5m in the LCRCA area.

Table 7-1: Estimated direct GVA impacts of NOC operations (£m, 2025 prices)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025	Total by area
HSCCA	40.1	35.3	39.6	35.9	150.8
LCRCA	10.2	9.0	10.1	9.2	38.5
Total	**50.3**	**44.3**	**49.7**	**45.0**	**189.3**

Source: SQW analysis of NOC data

NOC directly supported an average of 694 jobs annually across the impact period, with annual employment ranging from 647 to 732 jobs. Direct employment increased consistently, indicating sustained growth in NOC's workforce. The majority of direct employment was supported in the HSCCA area. The remaining jobs related to mariners, who cannot be assigned to a specific site.

Table 7-2: Estimated direct employment impacts of NOC operations (jobs)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025
HSCCA	447	468	509	518
LCRCA	114	119	130	132
N/A (mariners)	86	86	83	82
Total	**647**	**673**	**722**	**732**

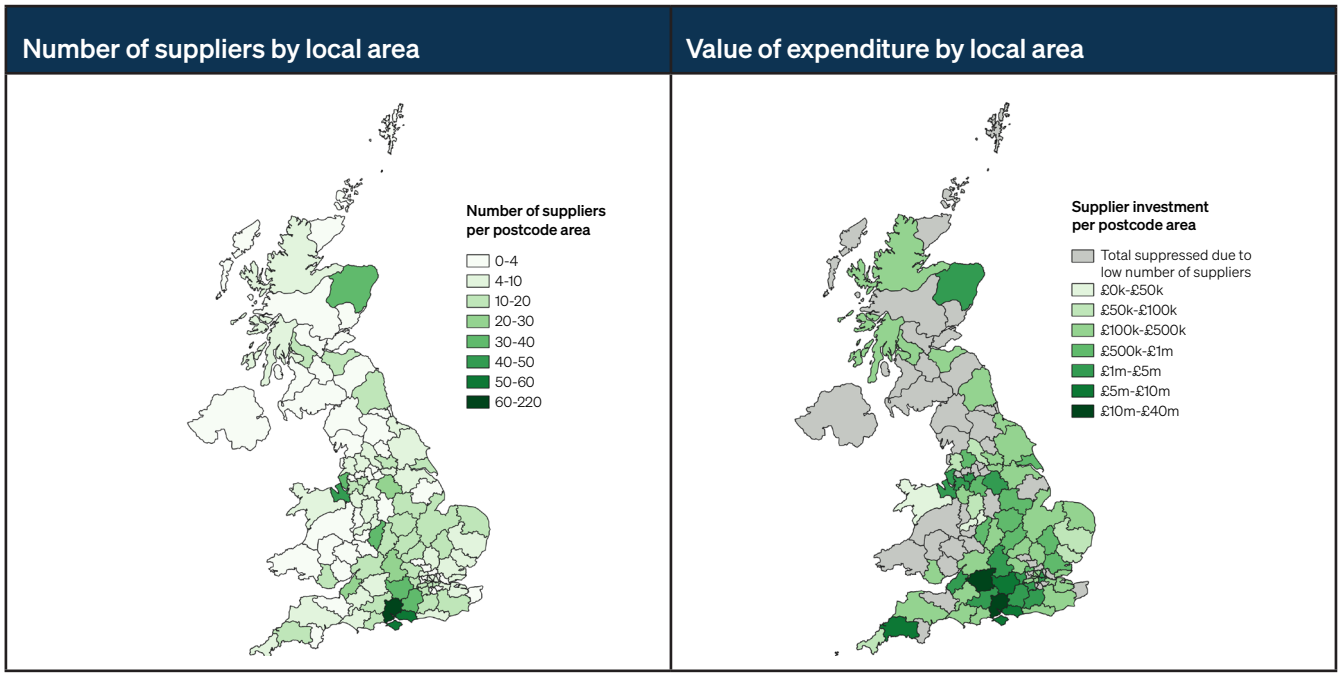
Source: SQW analysis of NOC data

IMPACTS OF EXPENDITURE ON GOODS AND SERVICES

NOC net supplier expenditure over the impact period was approximately £160.2m (in nominal terms). Figure 7-1 illustrates the breadth of NOC's supplier network across the UK. The data demonstrate that the location of key suppliers and procurement expenditure is widely distributed, supporting economic activity across the regions and nations of the UK. At the same time, the concentration of suppliers and procurement expenditure activity around its principal sites, notably in Southampton, highlights NOC's role in supporting local economies in the HSCCA and LCRCA areas.

NOC's expenditure on goods and services is estimated to have generated £116.1m in GVA across the UK economy over the impact period, equivalent to an average of £29.0m per year in 2025 prices. The majority of impacts were realised across the wider UK economy, reflecting the national reach of NOC's supply chain and the broad distribution of indirect supply-chain effects. However, NOC generated substantial value added within the areas in which it operates. Combined impacts within the HSCCA and LCRCA areas are estimated at £26.9m over the impact period.

Figure 7-1: Distribution of NOC's suppliers across the UK over the impact period



Source: SQW analysis of NOC data

Table 7-3: GVA impacts of NOC's expenditure on goods and services (£m, 2025 prices)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025	Total by area
HSCCA	5.6	6.7	5.6	6.1	24.1
LCRCA	0.7	0.8	0.7	0.7	2.8
Rest of UK	20.9	25.0	20.8	22.5	89.2
Total	**27.2**	**32.6**	**27.1**	**29.3**	**116.1**

Source: SQW analysis of NOC and ONS data

Through the demand it creates for suppliers and their supply chains, **NOC's expenditure on goods and services supported an estimated 396 jobs across the UK economy on average each year over the impact period**. Annual employment impacts ranged from 368 to 440 jobs, reflecting changes in procurement expenditure over time. An average of 92 jobs per year were supported within the HSCCA and LCRCA areas combined, with the remaining impacts distributed across the wider UK economy.

Table 7-4: Employment impacts of NOC's expenditure on goods/services (jobs)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025
HSCCA	76	91	77	84
LCRCA	9	11	9	10
Rest of UK	283	338	284	312
Total	**368**	**440**	**370**	**406**

Source: SQW analysis of NOC and ONS data

IMPACTS OF STAFF EXPENDITURE

NOC's expenditure on salaries, NI and pension contributions is estimated to have generated £138.2m in GVA across the UK economy over the impact period. This is equivalent to an average of £34.6m per year in 2025 prices. Annual impacts increased over time, reflecting growth in staff numbers. The majority of impacts were realised across the wider UK economy, although substantial impacts were also generated within the HSCCA and LCRCA areas, where combined GVA impacts are estimated at £54.6m over the impact period.

Table 7-5: Estimated GVA impacts of NOC's staff expenditure (£m, 2025 prices)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025	Total by area
HSCCA	9.7	10.1	10.8	11.7	42.3
LCRCA	2.9	2.9	3.2	3.4	12.4
Rest of UK	19.7	19.9	21.1	22.9	83.6
Total	**32.3**	**32.9**	**35.0**	**38.0**	**138.2**

Source: SQW analysis of NOC and ONS data

NOC's staff expenditure is estimated to have supported an average of 422 jobs annually across the UK economy over the impact period, with annual impacts ranging from 383 to 471 jobs. An average of 161 jobs per year were supported within the HSCCA and LCRCA areas combined, with the remaining impacts distributed across the wider UK economy. These impacts are additional to NOC's direct employment presented in Table 7-2 above.

Table 7-6: Estimated employment impacts of NOC's staff expenditure (jobs)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025
HSCCA	123	112	123	140
LCRCA	36	33	36	41
Rest of UK	258	239	258	290
Total	**417**	**383**	**416**	**471**

Source: SQW analysis of NOC and ONS data

SUMMARY OF IMPACTS

Taken together, the estimated impacts highlight the substantial economic contribution made by NOC's operations to the UK economy. **Over the impact period, NOC's operations generated a total of £443.7m in GVA and supported an average of 1,512 jobs annually.** Both annual GVA and employment impacts increased over the period, reflecting NOC's growth as an organisation and the expanding scale of its activities.

Table 7-7: Total UK GVA impacts of NOC's operations (£m, 2025 prices)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025	Total
Direct impacts of operations	50.3	44.3	49.7	45.0	189.3
Impacts from expenditure on goods and services	27.2	32.6	27.1	29.3	116.1
Impacts from staff expenditure	32.3	32.9	35.0	38.0	138.2
Total	**109.8**	**109.8**	**111.8**	**112.3**	**443.7**

Source: SQW analysis of NOC and ONS data

Table 7-8: Total UK employment impacts of NOC's operations (jobs)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025
Direct impacts of operations	647	673	722	732
Impacts from expenditure on goods and services	368	440	370	406
Impacts from staff expenditure	417	383	416	471
Total	**1,432**	**1,497**	**1,508**	**1,609**

Source: SQW analysis of NOC and ONS data

These estimates highlight the scope of NOC's operational economic footprint, extending well beyond the organisation itself. The results demonstrate how NOC's role as a major employer and purchaser of goods and services creates economic value throughout the wider economy.

IMPACT REFLECTIONS AND FUTURE PROSPECTS



Our commitment to exploring, understanding and learning about our ocean drives everything we do, from sunrise to sunset

IMPACT REFLECTIONS

NOC has a distinctive role as both a leading research and technology organisation delivering curiosity-driven and applied science, and a provider of national capability for the UK marine science community. This national capability includes the operation of two of NERC's global-class research ships, a fleet of underwater robots, hosting of specialist facilities, generation, curation and dissemination of data, leading long-term observation and research programmes, and the delivery of expert operations support and advice.

Reflecting this distinctive role, the breadth and scope of NOC's impact is considerable, spanning its four missions of Climate, Biodiversity, Hazards and Pollution, and Sustainable Marine Economy. NOC operates as a highly interconnected ecosystem in which research, facilities, observations, technology, partnerships and stakeholder engagement are reinforcing and complementary.

NOC generates significant impact directly through its curiosity-driven and applied research and technology development. This delivers new scientific discoveries, enhanced knowledge and improved understanding of the ocean through robust and highly cited publications and research outputs. NOC's research also provides the data, tools and capabilities required to address environmental challenges, climate change and secure sustainable economic opportunities from marine and coastal environments.

Drawing on and translating these activities through partnerships, commercial services, and dissemination of evidence, including open data, a key route to impact for NOC is **enabling other research organisations to deliver scientific advances, and public bodies and businesses to act and make better-informed decisions** supporting environmental protection and sustainable economic growth activity over the long-term.

This activity **generates significant economic value for society**, as demonstrated in this study via case examples. The case examples show how NOC has: informed flood defence planning and responses through work on coastal resilience; enhanced resilience of critical national infrastructure through work on subsea cables; supported evidence-based assessment of environmental risks and investment decisions relating to the extraction of seabed minerals through work on deep-sea mining, helping to ensure that if deep-sea mining does go forward, its effects can be properly measured, managed, and mitigated; and demonstrated novel ways to fund scientific research through industry partnerships through BORA.

NOC also provided vital support to Government in shaping the UK's approach and response to an international agreement intended to protect marine biodiversity across nearly two-thirds of the ocean; the Biodiversity Beyond National Jurisdiction (BBNJ) Agreement.

These examples are not exhaustive; many other case examples could have been selected from across NOC's wide-ranging activity over the impact period. However, they demonstrate strongly how its science, technology and expertise translate into real-world benefits, both in the UK and internationally.

In this context, alongside these case examples NOC generates wider impact. This includes: **informing policy, regulation and standards** to support sustainable development at national and international levels; **enhanced collaboration to address ocean-related challenges** through the development, facilitation and active contribution to networks and partnerships; and **developing the skills and capabilities of the marine science community** in the UK, including through supporting students, doctoral training, and practical experience to develop the skills pipeline. NOC also **manages national capability funding** on behalf of NERC, working in partnership with marine centres across the UK, ensuring that public investment is targeted and deployed effectively across the marine science ecosystem to deliver against strategic priorities.

There is also evidence that NOC has **supported businesses to start-up and scale-up**, including via the Innovation Hub in Southampton. More broadly, consultations suggest that NOC plays an important role in **maintaining and enhancing the UK's profile and position** in the international marine and ocean science research and policy community and is increasingly making an important **contribution to national security**, reflecting both the increasing convergence of ocean and defence technologies, and NOC's expertise in the design and operation of autonomous marine systems. NOC's role in **supporting place-based innovation** in Southampton and Liverpool is also an emerging area of impact.

Many of these impacts cannot be quantified. However, applying Government evidence on the long-term returns to public investment in R&D suggests that **UKRI-funded research and innovation activity undertaken by NOC during the impact period could generate £826-853m in discounted long-term economic benefits across the UK economy**. Taken together with an estimated £455m in GVA generated through NOC's commercial and operational activities,[23] this suggests **a total of £1,281-1,308m in economic value supported across the UK** and an indicative return of around £5 for every £1 of UKRI funding invested in NOC during the impact period.[24]

NOC's employment impact is also significant. Overall, it is estimated that NOC supported an average of c.1,500 jobs per year across the UK economy between October 2021 and September 2025. This was realised through direct employment of scientists, engineers and marine operations experts, and the indirect effects of its activities which generate economic activity in businesses across the UK. At the local level, NOC supported c. 700 and c.170 jobs on average each year in the Hampshire and Solent Combined County Authority and Liverpool City Region Combined Authority areas respectively over the impact period.

Taken together, **NOC's contributions align strongly with a range of UK national priorities**, including economic growth, innovation, climate resilience, environmental sustainability and national security. This alignment increases the relevance and potential value of NOC's activities by supporting areas identified as strategically important to the UK's future prosperity, resilience and sustainability.

23 Across the four-year impact period, NOC's operational and commercial activities generated £455m GVA across the UK economy, including an estimated £218m in the Hampshire and Solent Combined County Authority area and £54m in the Liverpool City Region Combined Authority area.

24 Based on UKRI investment and GVA benefits expressed in 2025 prices.

The impact study identified five features that underpin and amplify NOC's impact:

- **Long-term capability.** Core to NOC's impact is leveraging – and continuing to develop – capabilities that have been sustained over decades, including observing systems, datasets, infrastructure, technologies and specialist expertise.
- **The integration of scientific research, engineering, operational and technology impact pathways.** The reinforcing relationship between NOC's curiosity-driven and applied research, its engineering and operational expertise, and its technology development activities is essential to both its scientific and commercialisation potential.
- **Active collaboration and convening.** NOC collaborates with and convenes partners to shape priorities and deliver marine science and technology activity and engages extensively with both national and international organisations across its areas of focus. This collaborative approach is seen as both an internal strength of the organisation and a key impact mechanism.
- **Reciprocal benefits of co-location with partner universities.** Close relationships with the University of Southampton and University of Liverpool have mutual benefits for both NOC and partner universities in terms of research scope and capacity, reputation, talent attraction and access to facilities. Although this can make direct attribution of impact challenging, this reflects positively the deep and reinforcing nature of the partnerships, which also contributes to the wider marine economy in both areas.
- **Breadth aligned with focus.** NOC has significant breadth of expertise and capability across its scientific missions, engineering, digital activities and research infrastructure. However, this breadth is framed by a clear organisational focus: to enhance understanding of the ocean and translate that knowledge into societal value. NOC therefore combines broad capabilities with deep, specialist ocean expertise, enabling it to address complex challenges in an integrated and focused way.

FUTURE PROSPECTS

The evidence presented throughout this study suggests that NOC enters the next phase of its development from a position of considerable strength. Looking ahead, the principal opportunity is not a fundamental change in direction, but the continued evolution of how NOC delivers value. While scientific excellence remains central to its mission, **NOC's future contribution will increasingly be shaped by its ability to translate, convene, connect and amplify its capabilities across a wider range of organisations, sectors and decision-making contexts.**

Translation, application and commercialisation. One area of evolution is the growing importance of translational activity. The impact study has demonstrated multiple mechanisms through which NOC's research, technology and expertise contribute to societal and economic outcomes. Looking ahead, there is potential to further extend these routes to impact through the continued expansion of commercial services, technology licensing, spin-out activity and long-term strategic partnerships with industry. Evidence from the study also points to opportunities to build on NOC's growing engagement with sectors such as financial services and insurance, alongside the growing application of ocean science to wider questions of economic resilience, environmental risk and national security.

This includes opportunities in key growth sectors aligned to national economic priorities as set out in the Industrial Strategy including:

- **Clean Energy Industries:** offshore renewable energy, ocean carbon monitoring, carbon capture and storage and the sustainable marine economy
- **Defence:** including autonomous and robotic underwater systems and data collection in complex marine environments
- **Digital and Technologies:** including AI and autonomous systems.

Convening and influence. Consultees for the impact study identified opportunities for NOC to strengthen its role as a strategic convenor and recognised voice for the ocean sector. This includes building on existing leadership roles to become a more prominent focal point for engagement between governments at sub-national and national level, industry, investors and the research community on ocean-related challenges and opportunities in the UK and internationally. Looking ahead, there is potential for NOC to play a more visible role in strategic forums beyond the traditional marine science community, helping to ensure that ocean evidence is reflected in wider economic, environmental and policy decision-making.

Visibility and connectivity. The study suggests that enhanced visibility and connectivity have the potential to act as important multipliers of impact across many of the opportunities identified above. The evidence indicates that some of NOC's expertise, capabilities and contributions (e.g., around autonomous systems or defence) are not widely understood outside specialist communities, potentially limiting opportunities for collaboration, influence and impact. Strengthening NOC's visibility, communications and external engagement was therefore identified as an important enabling factor by consultees for this impact study that could support greater uptake of its expertise, new partnerships across research and innovation ecosystems, and wider application of its capabilities.

Local economies and ecosystems. NOC's contribution within Southampton and Liverpool is likely to become increasingly important alongside its national and international activities. While NOC's local impacts are already substantial, stakeholders pointed to opportunities for NOC to act as a more visible anchor institution, strengthening links across research, industry and public sector organisations and helping to connect local partners to national and international opportunities. This includes building further on the role of the Innovation Hub, supporting the growth of maritime and marine technology clusters, strengthening engagement with local innovation networks, and becoming more active in considering how NOC's skills pipeline can support local rejuvenation and the creation of high-quality jobs, including pathways for vocational and technical careers for young people, aligning with local colleges and skills provision. Consultations in both local areas also identified opportunities for NOC to scale up its local impact through engagement across broader scientific disciplines (e.g., data science and engineering), leveraging and broadening its strong relationships and co-location with its partner universities.

NOC's future contribution will also be framed by the strategic environment. Three strategic drivers are crucial: the Government's commitment to devolution and subnational economic growth; the increasing recognition by UKRI and other funders of the importance of place in driving innovation; and UKRI's mission to advance knowledge, improve lives and drive growth. Taken together, this provides a **significant opportunity for NOC to scale-up both its national and local impact, building on its deep roots in Southampton and Liverpool, and the alignment of its research and technology expertise with both local and national economic priorities.**



ANNEX A

METHODOLOGY AND ASSUMPTIONS

This Annex accompanies the final report of the impact study of the National Oceanography Centre (NOC). It provides further detail on the approach to developing the impact model for this assessment, including data sources and assumptions.

OVERALL APPROACH

The economic impact model quantifies the impact of NOC's activities over the four-year impact period from October 2021 to September 2025, reflecting NOC's financial year (which runs from October to September). It does so through three routes:

- quantifying the direct and indirect economic impact of NOC's operational activities, including the direct operational footprint and impacts through staff expenditure and supply-chain effects
- quantifying the impact of NOC's commercial activities delivered by NOC Innovations
- estimating the economic value to society of NOC's research using Government-published research on the productivity effects of public R&D research.

For impacts from operational and commercial activities, the model quantifies impacts in terms of gross value added (GVA) and jobs supported, employing the standard 'GVA to jobs' approach where the estimated GVA impact is converted into the number of supported jobs based on ONS's industry-level labour productivity estimates.[25] For impact of NOC's research, the model quantifies GVA impact only, reflecting the underlying Government evidence used.

Impacts were estimated for the UK as a whole for all three impact categories. For operational and commercial activities, this was completed by separate consideration of impacts within the Hampshire and Solent Combined County Authority (HSCCA) and Liverpool City Region Combined Authority (LCRCA) areas. International impacts were not quantified as part of the economic modelling but were considered qualitatively through other components of the study.

Importantly, while the analysis accounts for leakage where possible (e.g., by excluding economic activity occurring outside the UK from impact estimates), the estimated impacts have not been adjusted for deadweight (the extent to which the research, operational and commercial activities captured within the model would have taken place anyway in the UK in the absence of NOC, including through alternative allocations of public research funding), displacement (the extent to which NOC's activities may have reduced economic activity elsewhere), or substitution (the extent to which organisations engaged with NOC instead of pursuing other economic activity). The results should therefore be interpreted as gross impacts associated with NOC's activities.

Type I effects drawing on the UK Input-Output Analytical Tables have been used to capture indirect supply-chain activity, whereby economic activity directly associated with NOC supports additional economic activity among suppliers and other businesses further down the value chain.

All monetary values presented in the analysis are expressed in 2025 prices, with nominal values converted using HM Treasury GDP deflators to support comparison across years and the aggregation of impacts over the impact period.

25 With the exception of NOC's direct employment where NOC's staff numbers are used directly

Future GVA benefits associated with NOC's research activity were discounted to present values to reflect social time preference, whereby benefits realised in the future are valued less than equivalent benefits realised today. Estimates were tested using discount rates of 3.5% and 3.0%, reflecting the HM Treasury Green Book rate in place at the time of analysis and the Government's announced intention to reduce this rate.[26]

The modelling approach and key assumptions for each impact route are set out in the following sections. A consolidated list of data sources is provided at the end.

METHODOLOGY: IMPACT OF NOC'S OPERATIONS

NOC's operational activities generate impact through three channels: direct impacts of operations, impacts of expenditure on goods and services, and impacts of staff expenditure.

DIRECT IMPACTS OF OPERATIONS

COVERAGE

Direct operational impacts relate to NOC's own activities as an organisation. The analysis drew on a combination of information reported in NOC's Annual Reports and supporting datasets provided by NOC. Annual Report data was used to establish NOC's total income and employment over the impact period. This was supplemented with transaction-level supplier expenditure data provided by NOC. Information on the distribution of employees across NOC sites was also provided and used to apportion direct impacts between the HSCCA and LCRCA areas.

UNDERPINNING DATA AND MODELLING ASSUMPTIONS

Consistent with standard practice in economic impact assessments of research performing organisations, direct GVA was estimated using a production-based approach. GVA is calculated as total income less expenditure on intermediate goods and services, measured as net supplier expenditure. This reflects the value added by NOC through its own activities, excluding the value of inputs purchased from other organisations.

The table below sets out NOC's nominal income and supplier expenditure over the impact period. The resulting nominal GVA estimates were subsequently converted to real terms.

Table A-1: Data inputs for direct GVA modelling (£m, nominal terms)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025
Total income	78.7	85.4	86.2	87.9
Net supplier expenditure	34.8	44.3	38.3	42.9

Source: NOC Annual Reports; SQW analysis of NOC data

26 *Chancellor John Healey's Growth Speech 2026 - GOV.UK - https://www.gov.uk/government/speeches/chancellor-john-healeys-growth-speech-2026*

Direct employment impacts were taken directly from NOC's reported employment figures, with no further modelling required beyond apportionment between sites.

Apportionment of GVA and employment impacts between the HSCCA and LCRCA areas was based on information provided by NOC on the distribution of employees across sites.

Table A-2: Employee distribution across NOC sites

Employment location	%
Southampton	80%
Liverpool	20%

Source: SQW analysis of NOC data
Note: The percentage split is based on employee numbers excluding mariners who cannot be assigned to a specific site

IMPACTS OF EXPENDITURE ON GOODS AND SERVICES

COVERAGE

The analysis drew on transaction-level supplier expenditure data provided by NOC. The dataset included information on the value of expenditure, spend category and supplier location, enabling expenditure to be mapped to relevant industry sectors and geographic areas to provide a detailed and nuanced picture of economic impact. The transaction-level data provided a consistent basis for estimating the economic activity supported through NOC's expenditure on goods and services and the resulting supply-chain impacts.

UNDERPINNING DATA AND MODELLING ASSUMPTIONS

NOC's net supplier expenditure over the impact period was £160.2m in nominal terms (see Table A-1 above for an annual breakdown). Expenditure was mapped to industry sectors using supplier information and spend categories provided by NOC. Based on this mapping, industry-specific GVA-to-expenditure ratios were derived from the UK Input-Output Analytical Tables (Type I effects[27]). The ratios were applied to expenditure figures to estimate the GVA supported by NOC's supplier expenditure. The resulting GVA estimates capture the economic value generated among NOC's direct suppliers and across their wider supply chains.

These GVA estimates were then converted into the associated number of supported jobs using industry-level labour productivity estimates published by the ONS. This approach reflects differences in labour intensity across industry sectors, with the same level of GVA associated with different numbers of jobs depending on the industries in which it occurs.

The model disaggregated impacts between the HSCCA, LCRCA and the rest of the UK using supplier location data provided by NOC. Adjustments were made to account for expenditure with overseas suppliers that is delivered through UK-based operations (estimated by NOC at 15% of expenditure with overseas suppliers), and to reflect the fact that supplier location data captured the location of NOC's direct suppliers but not the location of businesses further down the supply

27 Type I effects capture both the initial economic activity generated by expenditure (often referred to as 'direct effects') and the subsequent supply-chain effects further down the value chain (often referred to as 'indirect effects'). They do not capture 'induced effects' arising from the expenditure of income earned by employees of supplier businesses. Note that the ONS does not produce official estimates for induced effects.

chain. Wider supply-chain effects were therefore apportioned across the HSCCA and LCRCA geographies according to their share of UK economic activity (GVA). The resulting spatial apportionment assumptions are shown in the table below.

Table A-3: Spatial apportionment assumptions for supplier expenditure impacts

	% of total impact
HSCCA	17%
LCRCA	2%
Rest of UK	63%
Outside UK	18%

Source: SQW analysis of NOC and ONS data

IMPACTS OF STAFF EXPENDITURE

COVERAGE

Staff expenditure impacts reflect the economic activity supported through NOC's expenditure on salaries, employer NI contributions and pension contributions. To estimate these impacts, Annual Report data on staff-related expenditure was combined with anonymised employee home postcode data provided by NOC, enabling impacts to be estimated at both a UK and sub-national level.

UNDERPINNING DATA AND MODELLING ASSUMPTIONS

NOC's expenditure on salaries, NI contributions and pension contributions over the impact period was £162.3m in nominal terms.

Table A-4: NOC's expenditure on staff costs (£m, nominal terms)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025
Wages and salaries	27.6	30.3	33.8	38.0
NI contributions	2.9	3.2	3.5	4.3
Pension costs	4.6	4.4	4.7	4.9
Total staff costs	**35.1**	**38.0**	**42.0**	**47.2**

Source: NOC Annual Reports

GVA impacts of this expenditure were estimated using UK Input-Output Analytical Tables and associated Type I effects. Specifically, salary expenditure was allocated across relevant industry sectors of the economy using consumer expenditure categories from the Consumer Prices Index (i.e. assuming that NOC staff spend their salaries in line with this) and converted into estimates of GVA using industry-specific GVA-to-expenditure ratios. NI and pension contributions were modelled separately using whole-economy conversion factors derived from the UK Input-Output Analytical Tables. The resulting GVA estimates capture the economic value generated through employee, government and pension fund spending, together with

the additional value generated as the recipients of this expenditure purchase goods and services from other businesses further down the value chain.

Consistent with the approach to goods and services expenditure, employment impacts were estimated by applying ONS labour productivity measures to the estimated GVA impacts. For salary expenditure, productivity assumptions reflected the sectoral composition of household spending derived from the Consumer Prices Index. For NI and pension contributions, impacts were estimated using whole-economy productivity measures.

The approach to spatial disaggregation differed between salary expenditure impacts and impacts associated with NI and pension contributions. Impacts from salary expenditure were apportioned using anonymised employee postcode data provided by NOC, with adjustments made to reflect savings, expenditure outside the UK, expenditure within the UK but outside employees' local area, and the fact that local spending is not fully retained within the local economy.[28] Impacts associated with NI and pension contributions were apportioned according to each area's share of UK economic activity (GVA). The resulting spatial disaggregation assumptions are shown in the table below.

Table A-5: Spatial apportionment assumptions for staff expenditure impacts

	% of total impact from salary expenditure	% of total impact from NI and pension expenditure
HSCCA	35%	3%
LCRCA	10%	2%
Rest of UK	50%	95%
Outside UK	5%	-

Source: SQW analysis of NOC and ONS data

METHODOLOGY: IMPACT OF NOC'S COMMERCIAL ACTIVITIES

COVERAGE

NOC provided detailed data on the income generated from its commercial services over the impact period to inform a quantification of the value generated for its clients and the economic impact in terms of GVA and employment. Data was provided at a transaction level, including details of the location of the client (including in the UK and internationally) and broad industry (using a bespoke NOC definition). This data also included commercial revenue generated through hiring out meeting rooms and conference facilities at its Southampton facility for meetings, seminars, lecture series, conferences or other events.

UNDERPINNING DATA AND MODELLING ASSUMPTIONS

NOC delivered commercial services with a nominal income value of £14.5m over the impact period. In modelling economic impact, the focus was on benefits for UK clients only – approximately three-quarters of the commercial income (£10.6m) was generated from UK-based clients.

28 Local expenditure does not translate directly into local economic impact because some spending occurs with businesses that have a local presence but operate nationally or internationally (for example, supermarket chains and other large retailers). A proportion of expenditure therefore leaks out of the local economy through purchases from non-local suppliers.

Table A-6: NOC's income from commercial services (£m, nominal terms)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025	Total
UK	1.1	2.2	2.1	5.2	10.6
Non-UK	0.0	0.4	0.3	3.1	3.9
Total	**1.1**	**2.6**	**2.4**	**8.3**	**14.5**

Source: SQW analysis of NOC data

This income (adjusted to real terms) is assumed to be equivalent to GVA, i.e. GVA impact is assumed on a 1:1 basis to the income generated by NOC. This is underpinned by the assumption that, on average, the return on investment has to be attractive for clients, and in a market, organisations would not purchase the service unless they expected to derive at least this minimum level of value.

The GVA impact has been converted into employment estimates based on ONS's GVA per job estimates for relevant industry sectors using transaction-level data provided by NOC (with broad industries of NOC's clients mapped to relevant sector codes).

METHODOLOGY: IMPACT OF NOC'S RESEARCH ACTIVITY

COVERAGE

The analysis drew on information reported in NOC's Annual Reports on income received from UKRI, including funding from NERC and other UKRI sources. UKRI income was used as a proxy for NOC's public research funding for R&D from UK sources and formed the basis for estimating research impacts.

UNDERPINNING DATA AND MODELLING ASSUMPTIONS

To estimate the long-term economic benefit to society of NOC's research and innovation activity, we drew on Government-published evidence on the returns to public investment in R&D.29 This research found that public R&D investment generates, on average, a 40% return in private sector productivity after six years – meaning that £1m of public R&D investment can be expected to raise annual private sector GVA by £0.4m six years later. We consider this a reasonable and pragmatic basis for estimating NOC's research impact, reflecting the inherent and well-recognised challenges in robustly estimating impacts from individual research and innovation pathways.

This productivity uplift was applied to NOC's £244.1m income from UKRI to estimate the impact of its research activities over the impact period.

Table A-7: NOC's UKRI grant income (£m, nominal terms)

	To Sep 2022	To Sep 2023	To Sep 2024	To Sep 2025	Total
UKRI NERC grant	57.6	50.8	54.1	47.5	210.1
UKRI other grants	6.4	10.8	9.4	7.5	34.0
Total	**64.0**	**61.6**	**63.5**	**55.0**	**244.1**

Source: SQW analysis of NOC data

29 *Returns to Public Research and Development - GOV.UK*

Impacts were modelled over a 10-year realisation period (starting from the sixth year following investment, consistent with the Government-published evidence), with values adjusted for inflation. The evidence from the Government-published research did not indicate that the productivity effect depreciates or decays over time (and so can be assumed to remain in place in perpetuity). However, to provide a cautious estimate, a 10-year impact realisation period was used. This means that the grant income secured in 2024/25 will first generate a return in 2030/31, and will continue to do so for 10 years, with the last year of generated benefits in 2039/40.

As these benefits accrue in future years, they were discounted using the Green Book discount rate. At the time of writing, the formal discount rate was 3.5% per year. However, the Chancellor of the Exchequer announced in September 2026 that it will be revised to 3.0%.[30] The GVA generated under both discount rate scenarios is therefore presented in the report.

DATA SOURCES

The table below sets out all data sources used in the analysis.

Table A-8: Data sources

Data source	Description	Link
NOC Annual Reports, 2021/22 to 2024/25	Annual accounts including income, expenditure and employment	www.noc.ac.uk/who-we-are/our-purpose/annual-reports
NOC's detailed income and expenditure data	Transaction-level income and supplier expenditure data	N/A (data provided by NOC)
NOC's anonymised employee home location data	Anonymised employee-level home postcode data	N/A (data provided by NOC)
ONS UK Input-Output Analytical Tables	Industry-by-industry output tables containing Type I effects	www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/datasets/ukinputoutputanalyticaltablesindustrybyindustry
ONS Output per job	Industry-level labour productivity estimates, UK level	www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/datasets/outputperjobuk
ONS Regional gross value added (balanced) by industry	Annual GVA estimates by ITL region	www.ons.gov.uk/economy/grossvalueaddedgva/datasets/
ONS Consumer price inflation	Basket of goods and services from the Consumer Prices Index including owner occupiers' housing costs (CPIH)	www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceinflation
HM Treasury GDP deflators	The latest gross domestic product (GDP) deflators used to calculate real terms values	www.gov.uk/government/collections/gdp-deflators-at-market-prices-and-money-gdp

Source: SQW

30 *Chancellor John Healey's Growth Speech 2026 - GOV.UK - https://www.gov.uk/government/speeches/chancellor-john-healeys-growth-speech-2026*

ANNEX B

IMPACT CASE EXAMPLES

This Annex accompanies the final report of the impact study of the National Oceanography Centre (NOC). It presents the full impact case example write-ups, which are summarised in one-page formats in the main report.

BLUE OCEAN RESEARCH ALLIANCE® (BORA)

WHY NOC IS INVOLVED AND WHAT IT IS LOOKING TO ACHIEVE

Understanding the state of the ocean requires observations across a wide range of locations. However, the global scientific community has limited capacity to collect such data at scale, with ocean observations constrained by the availability of specialist research vessels, equipment and infrastructure. By contrast, offshore industries operate vessels, remotely operated vehicles (ROVs) and other infrastructure continuously across large areas of the world's ocean. This creates an opportunity to leverage industrial operations to advance scientific understanding of the ocean at scale.

BORA Blue Ocean Research Alliance® (BORA) was established in 2021 as a partnership between NOC and Subsea7, a global offshore energy services company, **to integrate scientific observation into routine offshore operations and collect scientific data that would otherwise be unavailable or prohibitively difficult to obtain**. The opportunity is particularly significant because of the scale of Subsea7's operations. While NOC operates two research ships and one ROV, Subsea7 has a global fleet of vessels and around 120 ROVs. This enables observations to be gathered on a much larger scale than would be possible through conventional research programmes, including in locations and operational environments that would otherwise be difficult for the scientific community to observe.

> ***"It's about expanding our capability to observe the ocean. Essentially that's the main purpose."***
>
> Internal consultee

Beyond data collection, BORA was also established to **demonstrate a new model of science-industry collaboration**, in which industry assets and operations are used to support scientific research. The idea emerged from earlier attempts by NOC scientists to access Subsea7 infrastructure for research purposes, which demonstrated both the scientific value of these assets and the opportunity for a more systematic approach. BORA has since been recognised through endorsement by the UN Decade of Ocean Science for Sustainable Development; one of the first science-industry partnerships to receive this recognition, and – more recently – through a 2026 Global Offshore Wind Awards win for Environmental Excellence.

NOC'S ACTIVITIES AND HOW THIS IS EXPECTED TO LEAD TO POSITIVE IMPACTS

BORA is not a single research project, but a framework through which research projects are developed, funded and delivered using a combination of NOC's scientific expertise and Subsea7's assets and operations. Projects are selected by NOC based on scientific relevance and operational feasibility, with the underlying principle that scientific data should be collected alongside routine offshore activity, minimising disruption to offshore operations while extending the reach of ocean research. Wherever possible, data generated through BORA are intended to be made openly available, allowing researchers beyond NOC to benefit from and build on the outputs of the alliance.

A core strand of activity is **BORAbox**®, a package of sensors integrated onto offshore infrastructure and ROVs to collect Essential Ocean Variables used to monitor how the ocean responds to climate change. Existing NOC sensor technologies were adapted for use in commercial operational environments, enabling data collection without specialist scientific personnel being present. The resulting data is processed by NOC scientists and, in the longer term, is intended to contribute to wider ocean observing initiatives and ocean health assessments, providing evidence that can support climate adaptation efforts.

A second major activity is **Eyes in the Ocean**, which uses Subsea7's global fleet of ROVs to gather biodiversity observations. Images and footage are reviewed by NOC scientists, providing new information on the distribution and abundance of deep-sea species, including rarely observed organisms such as sleeper sharks and bigfin squid. The resulting observations are intended to contribute to wider biodiversity datasets and associated research, providing evidence that can support future conservation and ecosystem management efforts.

> ***"This is where industry and science coming together is powerful because we have the data they would not normally have had access to."***
>
> External consultee

BORA has also supported targeted scientific projects. For example, the **Sediment Flux Project** used operational data from the Black Sea to investigate the causes of underwater sediment flows that damaged offshore infrastructure, generating new insights into geohazards relevant to both science and industry. The **Essential Fish Habitat Mapping Project** in Brazil combined NOC's environmental modelling expertise with the local ecological expertise of Brazilian researchers to identify habitats suitable for the endangered grey triggerfish, supporting future conservation and restoration efforts and helping to protect an important food source for local communities. The **Sediment Sampling Project** has used ROV push cores collected during routine offshore operations to obtain high-value seabed samples, expanding access to scientific material and environmental data that would otherwise be costly and difficult to collect at scale. Several new activities are also being developed, including projects focused on environmental DNA (eDNA) and microplastics.

Beyond research, BORA includes **engagement and dissemination activities**. Findings from the alliance are shared through scientific publications, conferences and industry events (e.g., American Geophysical Union annual meetings, Offshore Technology Conference), the BORA website, social media, newsletters and webinars. BORA also contributes to NOC's wider engagement with the UN Decade of Ocean Science for Sustainable Development and associated scientific initiatives and networks, including Challenger 150, the Deep Ocean Observing Strategy (DOOS) and Joint Exploration of the Twilight Zone Ocean Network (JETZON).

PARTNERS AND STAKEHOLDERS ENGAGED WITH NOC

Subsea7 has played an instrumental part in establishing, funding and enabling BORA, contributing its offshore operational capabilities, global infrastructure and engagement with clients to give the alliance the scale and reach it has today. Through BORA, NOC has connected not only with Subsea7, but also a wider range of offshore energy companies that Subsea7 serves. These include major energy companies such as BP, Aker BP, TotalEnergies, ExxonMobil, Turkish Petroleum, Equinor and Woodside Energy, which have supported BORA through access to infrastructure and, in some cases, funding. **Engagement with these organisations has also allowed NOC and Subsea7 to test different approaches to industry-supported research,** exploring how companies can contribute funding and in-kind support in ways that align with scientific priorities whilst being attractive for commercial partners. Through this process, NOC and Subsea7 have developed and iterated funding models, generating learning on what encourages industry participation and **how scientific research can be supported without treating it as a conventional commercial data-collection exercise**.

BORA has also enabled collaboration with research organisations and universities in locations where Subsea7 operates. The Essential Fish Habitat Mapping Project in Brazil involved collaboration with Instituto Federal do Espírito Santo (IFES), which brought expertise in grey triggerfish ecology and captive breeding. NOC contributed specialist skills in data integration, environmental modelling and habitat mapping, which were not available within the local research team. Through the project, NOC combined these capabilities with local scientific knowledge to address a regionally important research challenge, **demonstrating how its expertise supports and strengthens the work of international research partners**.

> ***"The main thing is that [the Brazilian researchers] now have a link to NOC and have been developing valuable science."***
>
> External consultee

THE IMPACTS GENERATED

The most significant impact of BORA to date has been the demonstration of a new model for conducting and supporting marine science. Through the alliance, NOC and Subsea7 have mobilised industry investment into marine science (c. £2.1m in the first five years of BORA) and generated practical learning about how scientific and commercial partners can work together while maintaining scientific independence and relevance. Through this work, NOC has helped demonstrate a potential blueprint for science-industry partnerships, positioning it at the forefront of efforts to develop new approaches to conducting and funding marine research.

> ***"That's what the BORA projects are supposed to be: they're win-win for everybody, as well as local communities, as well as the science, as well as industry."***
>
> External consultee

The significance of this contribution extends beyond BORA itself. Greater engagement with industry in ocean observation had been identified as a priority by the international scientific community, including at the 2019 OceanObs conference. BORA represents one of the first large-scale demonstrations of how this can be achieved in practice. Recognition by the UN Decade of Ocean Science for Sustainable Development subsequently provided opportunities for NOC to share learning from the alliance with international research networks and stakeholders, **creating additional routes through which NOC can inform wider strategic thinking in the marine science sector**.

Beyond its contribution to research model innovation, **BORA's scientific activities have begun to generate evidence, knowledge and insights that create pathways to longer-term economic, societal and environmental benefits**. For example, through the Sediment Flux Project in the Black Sea, NOC identified the causes of subsea infrastructure damage. Findings were shared with Subsea7 and one of its clients, which is expected to contribute to greater resilience of future offshore infrastructure projects and avoided economic costs. In Brazil, NOC's habitat mapping work has generated new evidence to support future restoration of grey triggerfish populations. While restoration activities are still ongoing, there is potential for downstream benefits through improved food security and economic outcomes for local fishing communities that depend on the species. Environmental and climate-related benefits are also expected to emerge over time as BORA-generated observations feed into wider ocean health assessments and climate research. There is also potential for future eDNA projects to generate evidence that informs discussions between regulators, governments and industry on the decommissioning of offshore infrastructure. In addition, the open availability of BORA-generated data creates opportunities for wider use by the research community, amplifying the alliance's downstream impacts.

BORA has also generated technology-development benefits by providing a real-world testing environment for NOC's 'lab-on-chip' sensor technologies. Operating sensors through commercial offshore activities exposed them to conditions that would

not normally be replicated through scientific deployments, helping NOC improve their robustness and reliability. This has created value beyond the immediate partners, as the technology is licensed to ClearWater Sensors, which supplies sensors to customers including government agencies, utility companies and research organisations.

> ***"It was of real value to us scientifically, but also to industry in understanding the challenges that they face when working in the deep ocean."***
>
> Internal consultee

The partnership model has also created wider value for offshore industry, including greater understanding of the marine environments in which offshore operations take place and broader technology development. For Subsea7 specifically, participation in BORA has also enabled deeper engagement with employees and clients around scientific and environmental issues, helping to demonstrate the company's commitment to supporting ocean science. It has also opened up wider avenues for collaboration with NOC beyond the alliance's core projects, for example by connecting Subsea7 staff working on carbon capture and storage with relevant NOC experts.

Finally, **the alliance has generated education, skills and capability benefits**. Data generated through BORA has contributed directly to postgraduate training through a PhD project at the University of Southampton and a master's project in Trinidad, helping develop the next generation of marine researchers. BORA has also provided opportunities for early-career NOC researchers to lead smaller demonstrator and proof-of-concept projects, helping to build capability in project leadership. In addition, through the Eyes in the Ocean project, offshore industry personnel have become active contributors to scientific research, helping improve ocean literacy among people working at sea.

THE DISTINCTIVE CONTRIBUTION AND ADDED VALUE OF NOC

NOC's distinctive contribution to BORA lies in the combination of scientific, analytical and engineering capabilities it brings to the partnership. While Subsea7 provides access to offshore infrastructure and global reach, NOC identifies the scientific questions that can be addressed through these assets, deploys specialist sensor technologies, and translates observations into evidence relevant to science, industry and environmental decision-making. NOC's scientific reputation and credibility have also been important, helping to ensure that learning and evidence generated through BORA is recognised in the wider marine science community.

> ***"We bring the scientific expertise and the understanding of the need for these sorts of data and recognising the opportunity."***
>
> Internal consultee

Looking ahead, BORA is set to build on this foundation over the next five years. Subsea7's board has approved an extension of the alliance to 2031, providing a platform to expand its scientific activities and reach further. This reflects the longer-term significance of the partnership as a continuing source of research value and as a model for science-industry collaboration.

COASTAL RESILIENCE

WHY NOC IS INVOLVED AND WHAT IT IS LOOKING TO achieve

> ***"Overall, the challenge is that coastal systems are evolving. We focus on coastal hazards and how we might mitigate against these"***
>
> Internal consultee

The UK's coastlines are changing, affecting coastal communities, economies and infrastructure. Climate change, including rising temperatures, changing weather and higher sea levels, is increasing the risk of flooding, storm surges, erosion, sandbank movement and salt encroachment. These risks are significant given the importance of coastal areas to the UK: over a third of the population (36%) lives within 5km of the coast and 6.1 million live in flood-prone areas. Coastal areas also support substantial economic activity including tourism, which generates over £13.7bn in England alone and attracts around 270 million visitors to UK coastlines each year. Critical infrastructure is similarly exposed, including nuclear power stations, railway lines and water treatment facilities. As sea levels rise, annual damages from coastal floods, which stand at around £540m, are expected to increase, with consequences extending beyond physical damage to public safety, economic productivity, transport connectivity and ecosystem health. NOC aims to provide intelligence, insight and understanding of how and why coastal systems are changing, to inform practical action. Improving the data, knowledge and predictions of ocean and coastal processes means that coastal management planning and mitigation measures can be carried out with greater certainty and be tailored to ensure greater efficiency and cost-effectiveness. NOC strives to make its research and data as comprehensive and integrated as possible, covering local areas and multiple hazards, by continuously developing technologies to enhance research capabilities, improve monitoring, and connect scientific evidence to actions that increase the resilience of coastal populations, infrastructure and ecosystems.

NOC'S ACTIVITIES AND HOW THIS IS EXPECTED TO LEAD TO POSITIVE IMPACTS

Crucial to supporting coastal resilience is reliable, up-to-date data on which planning decisions and damage mitigation measures can be based. Over the past four years, **NOC has undertaken a wide range of research and developed cutting-edge technologies to enhance the evidence base on coastal dynamics and to obtain more comprehensive data.** For example, in 2022, NOC led the UK's contribution to the Surface Water and Ocean Topography (SWOT) mission in collaboration with US, French and Canadian space agencies. The mission launched a satellite equipped with radar technology to observe water levels and currents across wider areas of the ocean in greater detail. SWOT data facilitated the development of NOC's intertidal mapping activities, which measure how sandbanks migrate and beach levels change, offering greater evidence to inform coastal management and infrastructure planning decisions. Other examples include working closely with Coastal Marine Applied Research (CMAR) to improve the evidence base on wave overtopping (the occurrence of waves exceeding sea defences), and developing a new framework to advance scenario modelling and investigate green solutions to coastal protection. A model for forecasting wave overtopping, based on AI models and other measurements, has also recently been launched in partnership with the University of Plymouth Coastal Process Research Group to support mitigation of this coastal hazard.

NOC also operates technologies and licences its technologies and expertise to support other organisations. For example, NOC operates underwater gliders for the Met Office, which collect water temperature measurements across substantial areas of the North Sea. These measurements feed into the Met Office's weather forecasting models, offering more accurate predictions of potential floods and storms. Similarly, Liverpool-based SME CoastSense licences NOC radar IP, enabling the company to collect data on beaches, waves and tides to help customers plan for storm damage and erosion.

NOC makes most of its datasets and research open source to support researchers, decision makers and planners in coastal resilience. Its data are used in academic research, including supporting doctoral research at the University of Southampton. NOC complements its data provision activities with specialist data quality assurance and software implementation services. Organisations use NOC's tide gauge data to validate their own measurements and commission NOC to perform data quality assurance activities. For example, since 2021 NOC has worked with the Met Office to quality control tide gauge observations, improving forecast accuracy by enabling bias correction. NOC has also developed open-source software for assessing ocean model performance and has been commissioned to implement these capabilities internationally, including for forecasting models in India.

> ***"NOC being part of our observational supply piece is really important to us – the glider and tide gauge in particular"***
>
> External consultee

Drawing on its coastal resilience research and technology development expertise and experience, NOC **contributes to climate reports, validation activities and information sharing.** NOC hosts the National Tidal and Sea Level Facility (NTSLF), which monitors sea levels and provides real-time forecasts, measurements and archived tide-gauge data. This supports flood forecasting bodies such as the Environment Agency and Met Office, informs marine management and coastal engineering, and provides evidence to inform policy. Further, NOC's research exploring how coastal habitat restoration can help ecosystems store carbon and mitigate climate change has informed local authorities about the coastal management options available in their areas. More widely, NOC helped shape national and international research agendas by contributing to the Met Office *State of the UK Climate* reports for several years and to the technical report of the *Climate Change Risk Assessment 4* which sought to communicate climate risks and actionable advice. NOC also contributed to advisory groups including the Natural Hazards Partnership; Scientific and Technical Advisory Committee (STAC) for the Copernicus Marine Service; and responded to All-Party Parliamentary Group enquiries related to marine climate resilience and hazards.

PARTNERS AND STAKEHOLDERS ENGAGED WITH NOC

To ensure its research contributes to practical solutions for coastal resilience, NOC **aligns research interests with key stakeholders and collaborates widely with academic and research institutes, government and public bodies.** Examples include working with the Universities of Liverpool, Southampton and Plymouth, the UK Centre for Ecology & Hydrology, and the British Geological Survey. NOC is also involved in international research partnerships through specific initiatives associated with the UN Ocean Decade Coastal Resilience Programme and All-Atlantic Ocean Research and Innovation Alliance.

> ***"We always try and work with different partners to ensure that anything we develop is useful to those that work in coastal management"***
>
> Internal consultee

NOC's collaboration with the Met Office is a particularly important strategic partnership. The Met Office utilises NOC's ocean models to inform its weather forecasting models which are then operationalised to predict storm surges and flooding. The Met Office provides a pathway through which NOC's work can be integrated and translated into a service informing decision makers about coastal hazards. The partnership continues to evolve, with both organisations recently collaborating to understand the impacts of marine heatwaves.

NOC has also developed a partnership with the Environment Agency (EA) and increasingly works with the EA on a bilateral basis. NOC supports the EA in using NOC's datasets and is collaborating on how emerging modelling systems could inform EA flood and coastal risk predictive systems. NOC's work on nature-based responses to coastal flood and erosion

management and seagrass restoration exemplifies its cooperation with other public bodies including Natural England, NatureScot and the Scottish Environment Protection Agency. Strong links with local authorities are also key to NOC's work, given that local authorities have responsibility for implementing coastal adaptation measures.

Beyond the public sector, NOC's technologies are applied through commercial partners such as CoastSense, which uses NOC's radar capabilities to provide monitoring services to clients including local councils, research institutions and engineering consultants. Together, these partnerships provide important routes through which NOC's research informs decision-making, forecasting and coastal management.

THE IMPACTS GENERATED

NOC's coastal resilience activities generate three key categories of impact.

First, **increased resilience of communities, infrastructure and ecosystems from coastal hazards**. NOC's improved data and technology feed into forecasts of storm surges and flooding which decision makers use to take short-term action (e.g. issuing public health warnings, managing transport networks, operating flood barriers). Without these forecasts, decisions rely on less accurate information and risk leaving populations and infrastructure vulnerable to floods and damage. NOC's partnerships with the Met Office and EA help to translate NOC's scientific contribution into actionable coastal resilience measures: the Met Office feeds NOC's data into its weather forecasting models, and the EA accesses these and other data to improve accuracy of water level predictions, which inform flood barrier closures. The potential cost of flood damage is in the billions, considering the Thames Barrier alone protects £321bn of residential property, 1.42m people and over 300km of major roads.

> ***"The cost savings from the storm surge work are in the billions in non-flooded London."***
>
> Internal consultee

More broadly, NOC's research has influenced long-term coastal resilience strategies. For example, through the Co-Opt project, NOC contributed evidence for nature-based coastal management options in Falkirk Council's shoreline planning. Specifically, an option for salt marsh restoration was added as a policy option offered by the council for a planned public consultation which would not have been proposed without NOC's input. NOC's contribution therefore improved the public decision-making process by offering a more complete list of potential future pathways for managing saltmarsh habitats which are valuable natural assets in the UK, estimated to have an existence value of £991 per hectare.

Second, **increased confidence in the execution of coastal hazard mitigation activities, enabling infrastructure to be designed more efficiently and avoiding unnecessary intervention and expenditure**. For example, NOC has developed improved iterations of models for the Met Office in response to feedback on model functionality, and provides quality control on flood forecasting observations which have "substantially increased the accuracy of data" (External Consultee) sent to Met Office customers. This is important for operational decisions that require high accuracy, and improved estimates reduce uncertainty and the need to over-engineer coastal management infrastructure, offering substantial cost savings where just 100 metres of seawall can cost close to £1m.

NOC's radar monitoring and intertidal mapping technologies were also utilised by CoastSense to determine that sediment accumulation at the entrance to the Manchester Ship Canal was likely to resolve naturally, avoiding the need for costly mitigation measures and years of planning. Similar instances have occurred at Morecambe Bay and the Mersey Estuary where radar tracked meandering water channels and coastal erosion threats, helping to inform local authorities, and private stakeholders, such as local port authorities, on when action is needed to protect coastline assets. NOC's technologies

therefore provide enhanced scientific insight that helps organisations understand and respond to coastal hazards.

Third, **technologies developed by NOC contribute to reduced costs and resource requirements associated with coastal monitoring, due to their ability to measure ocean processes at scale**. By centralising software and measurement capabilities, NOC enables tools to be deployed across multiple regional settings, avoiding the need for the development of bespoke models in each case. This reduces the cost of commissioned projects and increases the coverage of monitoring activity. Organisations commissioning NOC's technology also benefit from efficiencies and cost savings associated with their activities. For example, the Met Office outsources robotic glider operations and data assurance expertise to NOC as needed, avoiding the need for permanent in-house capacity. Further, NOC's radar technology continuously monitors coastlines at a relatively low cost, providing reliable data on a day-to-day basis. In contrast, drone-based approaches can be costly to deploy repeatedly and capture only snapshots of ocean dynamics, making NOC's technology particularly cost-effective for long-term coastal monitoring.

THE DISTINCTIVE CONTRIBUTION AND ADDED VALUE OF NOC

NOC's distinctive strength in coastal resilience lies in pushing the boundaries of knowledge and technology while translating this expertise into practical benefits for decision makers, researchers and the public. NOC's ability to do so is underpinned by a flexible research environment that enables it to pursue ambitious, long-term research programmes and explore innovative ideas.

The longevity of NOC's research teams supports the accumulation of expertise and enables NOC to influence the direction of research in coastal resilience. For example, early work on marine and land-based radar found that there were insufficient UK tidal data to support intertidal mapping technologies. NOC influenced data acquisition efforts so that intertidal mapping could become feasible, creating opportunities for new services to improve coastal resilience.

NOC's specialist infrastructure and reputation in coastal resilience also support its research teams to experiment and refine technologies, and to contribute knowledge on an international scale. Partners such as the Met Office benefit from access to NOC's facilities, equipment and knowledge that would otherwise be difficult or costly to obtain, and collaboration with NOC strengthens the credibility of funding bids and research programmes. In particular, international consortia focused on coastal resilience are reported to recognise NOC's input as "world-leading" (External Consultee) and trust the organisation as a partner whose contribution can enhance their prospects of securing Horizon Europe and other European funding. Together, these capabilities allow NOC not only to advance understanding of coastal processes, but also to translate research into technologies, services and evidence that support real-world coastal resilience decisions.

SUBSEA CABLES

WHY NOC IS INVOLVED AND WHAT IT IS LOOKING TO ACHIEVE

Subsea cables are key infrastructure for modern economies. However, there is a need to improve understanding of how cable networks are at risk from hazards and how they interact with the deep-sea environment. Targeting these gaps ensures the continued connection of power and telecommunications networks by providing the data, knowledge and evidence base needed by policymakers and commercial organisations. NOC's work in this area is looking to address three main gaps in evidence.

First, risks to subsea cables from geohazards and human-made hazards: This includes identifying emerging damage hotspots for geohazards such as underwater volcanoes and landslides, sediment avalanches, earthquakes and tropical cyclones. Evidence is also needed on harmful fishing practices which may move into cable routes in response to warmer waters driven by climate change. With large areas of the deep ocean unobserved, this analysis helps organisations and nation states to avoid costly subsea damage and potential disruption in the supply of power and telecommunications by better informing cable routes.

Second, the environmental impacts of subsea cables: This includes considering the impacts of the installation, decommissioning or recovery of cables, including biodiversity impacts and the potential disturbance of carbon in the seabed. This is needed to inform how and where regulation should be applied for these processes.

Third, opportunities for cable sensing: Subsea fibre-optic cables can act as large-scale sensing networks due to their measurable sensitivity to outside disturbances, such as pressure changes, vibrations and acoustic signals. This is an emerging area of research which offers a cost-effective method for continuous ocean observation and a scalable early warning system for natural hazards such as earthquakes and tsunamis.

NOC'S ACTIVITIES AND HOW THIS IS EXPECTED TO LEAD TO POSITIVE IMPACTS

NOC conducts scientific research on subsea cables through the use of research ships, remotely operated vehicles and autonomous underwater vehicles to map and sample the seabed, and numerical modelling to simulate waves, currents, sediment transport and future climate scenarios to inform industry of potential risks to subsea cables. For example, in 2023, NOC assessed global hotspots where future climate change may impact cable systems.[31] Identifying emerging hotspots can be used to reduce the overall risk of hazard disruption by redirecting cable routes away from hotspot areas. Avoiding hazard damage also avoids the potential costs from disruption to UK international data traffic, more than 90% of which travels by subsea cable. £1.4 trillion of UK cross-border trading alone is estimated to pass through these systems daily.[32]

> ***"To make better informed decisions on [cable] routing, it is vitally important to understand how they exist in the marine environment "***
>
> External consultee

NOC synthesises its datasets and research for regulatory bodies and policymakers. NOC produces white papers alongside academic papers, with co-authors often from industry. Bridging the gap between academia and policy helps to communicate findings to regulators and policymakers who manage the seabed and set best practice for the industry. For example, in 2025, NOC worked with Defra and The Crown Estate, which manages over

31 *Climate change hotspots and implications for the global subsea telecommunications network - https://nora.nerc.ac.uk/id/eprint/533807/*

32 *Plan to toughen protections for subsea internet cables amid heightened Russian activity - https://www.gov.uk/government/news/plan-to-toughen-protections-for-subsea-internet-cables-amid-heightened-russian-activity*

70 active telecommunication cable systems across the seabed around England, Wales and Northern Ireland, to synthesise and create new analysis of the drivers for, and environmental considerations relevant to, the decommissioning of subsea telecommunications cables. This work informs The Crown Estate's decisions as a licensing body on whether cables should be recovered or left in situ.

Beyond national activity, **NOC provides expertise to international bodies** including the European Subsea Cables Association (ESCA), which represents the 118 commercial organisations across 18 countries and the International Cable Protection Committee (ICPC), which works with over 15 international governments to provide scientific advice and support policy development. This work seeks to inform international policy through ICPC's presence at treaty negotiations and Observer Status at the United Nations and ESCA's Observer Status at the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Commission.

NOC also contributes to the development of subsea cable sensing technology. Cable sensing is an emerging area of research which NOC is developing by investigating (a) what can be measured and how, (b) how to interpret cable sensing data, and (c) how the data can both improve resilience in cable networks and environmental monitoring. For example, NOC is working with the National Physical Laboratory on the Full Ocean Fibre project, funded by the Advanced Research and Invention Agency, to develop a new optical fibre sensing approach. This project is developing techniques to convert measurements taken from cables into findings which will provide new insights for ocean observation in the North Atlantic. This research will feed into climate models to improve the accuracy of future scenario modelling which assess the potential impacts of climate change.

PARTNERS AND STAKEHOLDERS ENGAGED WITH NOC

NOC engages with stakeholders from across the subsea cable industry in a variety of formats. NOC convenes with cable owners, installers, survey companies, government bodies and regulators through the Subsea Cables Awareness Workshop co-hosted with ESCA, and at industry conferences and events. Through the ICPC, NOC's work is also shared to thousands of mailing list subscribers through a biannual public publication, *Submarine Cable Protection and the Environment*. This publication '*translates the research developments into accessible information for cable owners, governments, those developing policy*' and is written by NOC's Strategic Research Lead for Hazards and Pollution.[33]

NOC shares findings with policymakers and regulators through responses to calls for evidence and participating in committees and steering groups, including those associated with the UK Department of Culture, Media and Sport, the Ministry of Defence, the Foreign, Commonwealth and Development Office, the Cabinet Office, the Marine Management Organisation (MMO), The Crown Estate and Crown Estate Scotland.

NOC has collaborated on research projects in this area with the National Physical Laboratory, NERC, and the University of Southampton, including supporting two doctoral students undertaking research on subsea cables, with NOC data and evidence made available to support their work.

THE IMPACTS GENERATED

Four categories of impact are evident from NOC's work on subsea cables. First, NOC has generated **peer-reviewed evidence and data to address evidence gaps and drive scientific progress**. As well as advancing scientific understanding – itself an important contribution – this evidence and data enables NOC to provide advice and guidance to regulators, commercial stakeholders and policymakers at both national and international levels.

33 *See here for details: Submarine Cable Protection and the Environment - iscpc.org/publications/submarine-cable-protection-and-the-environment/*

Second, and in this context, **NOC's work has strengthened and informed governmental policy, strategies, and agreements**. For example, in 2023, the United Nations adopted the Agreement on Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ) [*see case example below*]. NOC, as the only non-Government member of the UK Delegation for the Agreement negotiations, provided technical advice on the Agreement regarding the decommissioning of subsea cables in ecologically sensitive areas. NOC also worked with NERC and UKRI to establish processes with legally binding obligations to ensure compliance with the Agreement and the UK BBNJ Bill following ratification. Further, NOC contributed to the evidence base for The Crown Estate and the Department for Business, Innovation, Science and Trade's Marine Delivery Routemap through its research and analysis identifying international hotspots at risk of climate change. This Routemap is used by the UK Government and The Crown Estate to direct future cable investment planning and to assess the potential adoption of cable protection zones.

> ***"When we need to influence decision-makers, we would bring [NOC] in to support those discussions because they bring credibility and independence."***
>
> External consultee

Third, **NOC contributes to UK economic resilience and preparedness** reflecting the importance of subsea cables to data transmissions and connectivity. Notably, the 'First Report of Session 2024-26' from Parliament's Joint Committee on National Security Strategy noted that whilst the UK is a '*global hub for internet traffic*', there are vulnerabilities around the UK's outlying islands, military cables and the financial sector, with the UK relying on just two cables for 75% of the UK's transatlantic capacity.[34] Given £65 billion of UK economic activity relies on subsea cable industry and £1.4 trillion of daily UK transactions depend on these systems, the mitigation of disruption to subsea cables is critical for the UK's internet infrastructure and economic activity.[35,36] This report, which also assesses the potential advance warning time offered by cable sensing to report military threats, specifically references work produced by NOC, and published by the ICPC, alongside NOC work outlining best practice for seabed spatial planning and for promoting resilience of submarine telecommunications cables. NOC's work is also a source for the UK Government to assess potential disruption from geomagnetic storms.

Interest in cable sensing policy is growing as the technology develops. Stakeholders such as the UK Government and The Crown Estate are currently aiming to understand both the technology's environmental benefits and how the technology fits into the existing regulatory landscape. NOC's work and stakeholder engagement was noted as important in this context by case example consultees, offering an objective perspective on the technology and how it will interact with legislation.

Fourth, **NOC's work contributes to the avoidance of costs associated with damage and disruption to cables** by redirecting routes away from potential hazards. Individual telecommunications repairs can often cost ~$1 million, with power cable repairs potentially costing tens of millions. However, the economic cost of disruption is potentially far wider, particularly for harder to reach, small island nations.

> ***"NOC has provided a world-leading approach in bringing together the natural environment and the engineering and operation of submarine cables."***
>
> External consultee

34 *Subsea telecommunications cables: resilience and crisis preparedness - https://publications.parliament.uk/pa/jt5901/jtselect/jtnatsec/723/report.html*

35 *£65bn of UK economic activity relies on subsea cable industry - https://news-archive.hud.ac.uk/news/2016/september/65bnofukeconomicactivity reliesonsubseacableindustry.php*

36 *Plan to toughen protections for subsea internet cables amid heightened Russian activity - https://www.gov.uk/government/news/plan-to-toughen-protections-for-subsea-internet-cables-amid-heightened-russian-activity*

For example, in 2022, the Hunga volcanic eruption severed Tonga's sole international cable. Telecommunications to and from the island were cut, meaning a satellite phone was required to report the damage. The disruption restricted the island's economic activity, which shut down ATMs and, with 44% of Tonga's GDP coming from foreign remittances, sources of emergency cash for impacted communities were unavailable. Further, the disruption meant that islanders could not communicate digitally, halting businesses reliant on digital services alongside farmers unable to export produce. Repair of the cable took five weeks, with full broadband internet access for all islanders not restored until 18 months after the eruption.[37]

NOC worked with the industry and scientific partners to understand the damage three months after the eruption. NOC applied their research in collaboration with Tonga Cable Limited and other researchers from across the Pacific to help diagnose the faults to the cable and to select more resilient routes for repaired cables. NOC further advised on the future threats to infrastructure and contributed to the evidence base to justify a second international cable for the island of Tonga. Securing a second cable helps to improve resilience by reducing the risk of damage from hazards and minimising the economic impacts of disruption through the provision of an alternative international connection, increasing the resilience of telecommunications for the island's 103,750 inhabitants.[38]

THE DISTINCTIVE CONTRIBUTION AND ADDED VALUE OF NOC

NOC's position at the intersection of research, industry and government is a key strength in relation to subsea cables. Consultees consistently referenced NOC's ability to not only generate primary data and undertake research, but also to synthesise the results into formats suitable for industry and policymakers (e.g. white papers, industry publications and workshops) as a key benefit which aids decision making. Given the mix of science, engineering and political considerations associated with deep-sea cable networks, this ability was labelled by a case study consultee as a factor which '*helps to support cohesion in the way that industry stakeholders can work together because there is shared understanding*'.

> ***"It's that intersection between academia and regulation, policy, industry. They're very good at sitting at that intersection to the benefit of everybody."***
>
> External consultee

37 *Extremely offline: what happened when a Pacific island was cut off from the internet - https://www.theguardian.com/news/2025/sep/30/tonga-pacific-island-internet-underwater-cables-volcanic-eruption*

38 *World Bank Group Population, total - Tonga - https://data.worldbank.org/indicator/SP.POP.TOTL?locations=TO*

DEEP-SEA MINING

WHY NOC IS INVOLVED AND WHAT IT IS LOOKING TO achieve

Deep-sea mining (DSM) involves the extraction of mineral deposits from the seabed, typically at depths exceeding 1,000 metres. The deep ocean contains deposits of minerals used in batteries and other technologies essential to the net zero transition, including electric vehicles, wind turbines and solar panels. As demand grows for these minerals, DSM is increasingly being considered as a potential source, enhancing its strategic and economic importance. However, there are concerns that mining activities could cause environmental damage, with consequences for biodiversity, ecosystems, and the industries and communities that rely on healthy marine ecosystems.

> ***"We are, as far as we can be, neutral producers of knowledge that is then used for decision-making, to try and ensure that DSM as an activity takes place in as sustainable a way as possible"***
>
> Internal consultee

The International Seabed Authority (ISA) regulates mineral-related activities on the seabed beyond national jurisdiction, with states able to sponsor contractors undertaking exploration activities. To date, the ISA has issued several exploration contracts, but commercial-scale mining in international waters has not yet commenced. The UK has sponsored exploration activities undertaken by UK Seabed Resources Ltd (UKSR), which holds two ISA exploration contracts in the Clarion-Clipperton Zone, an environmental management area of the eastern and central Pacific Ocean.

The core objective of NOC's work in this area is to **strengthen the evidence base on the potential environmental impacts of DSM and the wider trade-offs associated with its development**, helping to inform policy and decision-making relating to its management and regulation.

NOC'S ACTIVITIES AND HOW THIS IS EXPECTED TO LEAD TO POSITIVE IMPACTS

Research has been aimed at improving understanding of deep-sea ecosystems in areas potentially affected by DSM, with assessments of the potential impacts of mining requiring detailed knowledge of deep-sea biodiversity and ecological processes. Examples include biodiversity surveys and baseline assessments in the Clarion-Clipperton Zone and other deep-sea regions, on species distributions, environmental variability, and the factors that shape deep-sea ecosystems, such as seafloor topography, ocean chemistry and ocean currents. NOC researchers have also identified and described species previously unknown to science, including hard corals attached to polymetallic nodules and 24 new amphipod species.

NOC has also delivered applied research to examine how deep-sea ecosystems respond to disturbance and how potential impacts can be assessed and managed. This has included revisiting sites disturbed by experimental mining activities to assess ecosystem recovery. A key example is the £5m NERC-funded SMARTEX programme which, along with wider research, involved field expeditions and monitoring to assess change over 40 years after disturbance from experimental mining activities.

Drawing on fundamental and applied research, **NOC has regularly provided scientific evidence and expertise to UK Government (including Defra and FCDO) on DSM**, translating scientific evidence into accessible and practical findings for policymakers. This has included via participation in expert groups/networks, and providing scientific expertise to support government as a 'sponsoring state' for DSM exploration contracts.

NOC has also worked directly with DSM contractors to support the collection and interpretation of environmental evidence. This has included supporting the design of environmental surveys and analysing and interpreting data collected by

contractors. This work has contributed to the establishment of environmental baselines, supported regulatory requirements and marine spatial planning, and helped establish a basis for monitoring subsequent environmental change. In industry-funded programmes, NOC has sought to maintain its independence through open data and publication, and by retaining control over findings.

NOC has also provided scientific input to the International Seabed Authority (ISA) through participation in its regulatory and technical processes. NOC staff have served on the ISA's Legal and Technical Commission and other expert groups, and contributed directly to ISA recommendations and guidance documents. Specific inputs have included contributing to draft standards and guidelines for baseline data collection, participating in an expert process to develop environmental threshold values, including research on biological responses to turbidity, and developing policy briefs translating research findings for a regulatory audience.

NOC also supports skills and capacity building activities related to DSM. This has included delivering taxonomic training workshops and visiting fellowships, enabling scientists to develop expertise in identifying and classifying deep-sea species and undertaking taxonomy research. NOC has also provided technical, financial and scientific assistance to developing nations. Other capacity building activities include PhD studentships and training for scientists from around the world; NOC has funded two internships at the International Seabed Authority focused on data compilation and quality assessments.

These areas of NOC's research are often interconnected and can inform one another. For example, samples collected through biodiversity baseline surveys support species discovery and taxonomic research, while also leading to improvements in future environmental assessments and management.

PARTNERS AND STAKEHOLDERS ENGAGED WITH NOC

The Natural History Museum (NHM) has been a particularly important research partner, providing complementary expertise. For example, in research on fauna collected through DSM-related programmes, NOC has focused on crustaceans while the NHM has led work on polychaetes. NHM and NOC have also jointly led programmes including SMARTEX and industry-supported research. NOC has also worked with a wide network of UK research organisations on DSM, including Plymouth Marine Laboratory, the Scottish Association for Marine Science, British Geological Survey and Heriot-Watt University, alongside international scientific collaborators. NERC has been an important funder of this research.

Government and regulatory stakeholders include Defra, FCDO, the Joint Nature Conservation Committee (JNCC) and the ISA. NOC has also worked with UK and international DSM contractors, including UK Seabed Resources, Tonga Offshore Mining Limited, Nauru Ocean Resources, the German contractor BGR and the Belgian contractor GSR. Beyond these relationships, NOC makes research available to the wider scientific community through scientific publications and open data.

> ***"It's really important to ensure that some of these environmental regulations and standards are prepared with the best scientific information available. I think that's one of the real benefits of this collaboration with NOC."***
>
> External consultee

THE IMPACTS GENERATED

NOC's work has **strengthened understanding of deep-sea biodiversity, ecosystem resilience and the environmental consequences of DSM.** Demonstrating the scale of the contribution to advancing scientific understanding in the area, NOC researchers have published over 65 papers

on DSM-related issues since 2013, including approaching 30 in the impact period. Further, DSM-related projects have secured approximately £8.8m in research income over the past five years, of which more than £4.0m came from industry sources.

This understanding has also been used to **inform policy, regulatory and environmental management impact**. For example, NOC expertise contributed to work developing environmental threshold values and to assessments informing the design of Areas of Particular Environmental Interest, alongside contributions from other organisations and experts. NOC also contributed to draft standards and guidelines for baseline data collection, an important technical component of the Mining Code being developed by the ISA.

These examples demonstrate how **NOC's scientific evidence and expertise have directly informed international regulatory and environmental management processes to ensure that the economic opportunity from DSM is progressed in a sustainable way**. NOC's work has also built scientific and institutional capability; the research, data, collaborations and access generated through this work have increased NOC's capacity to undertake wider deep-sea science.

Longer-term environmental and economic impact will rely on how evidence is ultimately used. Central to NOC's contribution on DSM is its role as an *"honest broker"*: providing evidence to support decision-making rather than advocating for or against DSM. NOC's contributions will support efforts to reduce or better manage potential damage to deep-sea ecosystems. At the same time, the environmental evidence required for assessment, regulation and planning could play an enabling role in future economic activity if DSM is permitted to proceed.

THE DISTINCTIVE CONTRIBUTION AND ADDED VALUE OF NOC

NOC has specialist and long-standing expertise in deep-sea mineral resources and biodiversity, with a substantial concentration of researchers with expertise in these areas. **NOC also brings together a broad range of complementary scientific and technological expertise**. This includes, crucially, the capability to deploy autonomous and robotic systems to conduct research in deep-sea environments. NOC also works across the boundary between fundamental research and practical application, with an understanding of the policy, regulatory and industry contexts in which DSM research is used.

> ***"One of the things that makes NOC a very good contributor is that it combines scientific expertise with an understanding of more industry-related requirements."***
>
> External consultee

NOC's sustained relationships with policy, regulatory and industry stakeholders have provided established routes for its scientific expertise to feed into decision-making. Consultees engaged for the case example linked these relationships to NOC's sustained presence in the field, with larger teams and longer funding cycles supporting continued interaction with government.

BIODIVERSITY BEYOND NATIONAL JURISDICTION AGREEMENT (BBNJ)

WHY NOC IS INVOLVED AND WHAT IT IS LOOKING TO ACHIEVE

The Biodiversity Beyond National Jurisdiction (BBNJ) Agreement establishes a framework for the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction. The Agreement is structured around four main Parts: Marine genetic resources and benefit-sharing; Area-based management tools; Environmental impact assessments; and Capacity-building and the transfer of marine technology.[39] The first Part has particular implications for the marine science community: the Agreement requires all parties to meet new reporting standards, such as providing information before and after collection and recording and managing samples.

The BBNJ Agreement was adopted at the United Nations in June 2023 and signed by the UK in September 2023. NOC's involvement covered the formal negotiation of the international Agreement (from September 2018 to June 2023); and development and passage of UK legislation (from late 2023 to July 2026). NOC continues to support the preparation for, and implementation of, the Agreement including its first Conference of the Parties (COP).

A core objective of NOC's involvement was to **ensure that the Agreement, subsequent UK legislation, and implementation arrangements reflect the practical requirements of marine scientific research and avoid unintended or disproportionate impacts on UK marine science**. NOC's contribution also aligns with its mission to ensure that 'marine biodiversity is protected and thriving', given the Agreement's role in supporting the conservation and sustainable use of biodiversity in areas beyond national jurisdiction.

NOC'S ACTIVITIES AND HOW THIS IS EXPECTED TO LEAD TO POSITIVE IMPACTS

During formal negotiations of the international Agreement, which ran from September 2018 to June 2023, NOC was the sole non-government representative in the UK delegation. NOC representatives attended weekly discussions with UK Government officials and monthly informal dialogues with member states, and supported the development of UK negotiating positions. NOC offered rapid technical advice on proposals under negotiation, drawing on expertise in marine genetic resources and collections management, research vessel operations, and capacity-building and technology transfer to assess whether emerging proposals could be implemented in practice. In addition to providing advice, NOC staff participated directly in negotiations, acting as an independent chair of cross-UK government discussions, and directly negotiating capacity-building and technology-transfer.

During development of UK legislation, NOC helped government translate the Agreement into requirements that could be implemented in practice by the marine science community. NOC worked directly with the FCDO on specific implementation questions, including by assessing how proposed requirements would apply to research vessels, autonomous vehicles and gliders, when information about the collection of marine genetic resources should be provided, and how collected samples and associated information should be recorded and managed. NOC also played a coordinating role, bringing together relevant stakeholders to work through practical implementation issues. For example, it convened a meeting between the FCDO, NERC and ship managers at NOC and the British Antarctic Survey to discuss how the Agreement would apply to UK-owned research vessels. NOC also reviewed draft versions of the domestic Bill.

39 *BBNJ Agreement | Agreement on Marine Biological Diversity of Areas beyond National Jurisdiction - https://www.un.org/bbnjagreement/en*

During the preparation and implementation stage, NOC has continued to support the UK in international BBNJ processes. NOC has contributed to the UN Preparatory Commission responsible for developing practical implementation arrangements, including direct work on the future Clearing-House Mechanism, which is intended to facilitate the sharing of information and documents relevant to the Agreement. NOC has also helped convene scientific, legal and other expertise required to inform these processes. Alongside this, NOC has undertaken research to inform implementation, including publishing papers on implementation challenges and developing scientific approaches for area-based management tools and environmental impact assessments.

> ***"We're creating implementation pathways [...] and gathering the network of expertise to be able to do that in an informed and effective way."***
>
> Internal consultee

PARTNERS AND STAKEHOLDERS ENGAGED WITH NOC

UK government partners included FCDO and Defra (and BEIS, as it was), underpinned by formal and informal engagement routes. Formal routes included NOC's membership of the UK delegation, participation in stakeholder workshops and meetings, and a Memorandum of Understanding with FCDO's Ocean Policy Unit, under which NOC provides scientific and technical advice on specified ocean-policy issues, including BBNJ. Government officials were able to contact NOC directly for advice as specific scientific or technical questions arose.

NOC also worked closely with NERC, to understand and prepare for the implications of the Agreement for research vessels and seagoing science; NERC directly commissioned NOC to provide a summary of the Agreement. NOC also worked with the Natural History Museum to publish position papers relevant to the BBNJ Agreement.

Internationally, NOC drew on existing networks spanning scientific institutions and international organisations. These include universities, such as the UN World Maritime University in Sweden, other national oceanography centres, and collaborative groups such as the Ocean Facilities Exchange group. NOC played a coordinating role in bringing stakeholders and experts together at key points and also helping key partners to understand and prepare for the implications of the Agreement.

THE IMPACTS GENERATED

NOC materially informed UK negotiating positions and aspects of the international Agreement. In particular, case example consultee evidence indicates that aspects of the UK approach developed with NOC were subsequently reflected in the final Agreement. The UK was described as playing a prominent role in developing the Agreement, with leadership in areas supported by NOC. This was reported to have generated science-diplomacy benefits.

> ***"An awful lot of what ended up in the Agreement ... was actually taken from the UK process, which is very much something we worked on with NOC."***
>
> External consultee

NOC also helped to ensure that **UK implementation plans reflect the scientific and operational realities of marine research**. Its input has helped government identify requirements that were workable and proportionate, reducing the risk of unintended disruption or burden to the UK marine science community. In parallel, NOC also strengthened coordination and readiness for implementation across UK marine science. By connecting government, NERC, research vessel managers and the wider scientific community, NOC helped organisations understand emerging requirements and prepare for implementation.

NOC's contribution to the UK's BBNJ negotiations has been formally recognised by the UK Government. During the Bill's second reading in October 2025, a Defra Minister described NOC's support to the UK delegation as '*invaluable*'.[40] Further recognition includes an acknowledgement during the Bill's second reading, when NOC was described as having already played a '*huge role*' in supporting ocean health and as being expected to continue to play a key role in the UK's approach to BBNJ.[41]

> ***"[The NOC team were] really critical to developing the UK position negotiations, and to us being able to respond quickly to what other people were putting on the table"***
>
> External consultee

At the time of consultation, implementation of the BBNJ Agreement was still at an early stage and many of the Agreement's long-term intended impacts were yet to be realised. The Agreement is intended to provide a framework for improved governance of biodiversity in areas beyond national jurisdiction. Expected long-term impacts included the establishment of tools to protect marine areas, strengthened environmental impact assessment processes, equitable participation in marine science through capacity building and technology transfer, and improved sharing of benefits arising from marine genetic resources.

THE DISTINCTIVE CONTRIBUTION AND ADDED VALUE OF NOC

NOC's distinctive contribution stemmed from its combination of scientific, operational and policy expertise. This enabled it to not only provide scientific and technical advice but also assess how proposed requirements would work in practice.

NOC has trusted relationships with UK Government. NOC's track record in providing technical advice and operating in ocean policy processes ensured a high level of confidence in partners and enabled policymakers to access advice rapidly and throughout the development of the Agreement.

Finally, **NOC's established UK and international networks** enabled it to access and leverage wider expert perspectives and intelligence to help support the UK's negotiation, preparation and implementation action.

> ***"I think the key difference with NOC is that they have responsibility agreed with UKRI for managing UK vessels, and they are also used to being the UK delegation to an international organisation."***
>
> External consultee

40 House of Commons Hansard, BBNJ Bill Second Reading, 16th October 2025: Biodiversity Beyond National Jurisdiction Bill - Hansard - UK Parliament - https://hansard.parliament.uk/Commons/2025-10-16/debates/4C625B19-C0EB-4F8F-BE60-F1534F4393AA/a

41 House of Lords Hansard, BBNJ Bill Second Reading, 2nd December 2025: Biodiversity Beyond National Jurisdiction Bill - Hansard - UK Parliament - https://hansard.parliament.uk/lords/2025-12-02/debates/6A05DF6E-F2DA-4D63-A79B-A3D43017514D/Debate





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