

MASTS Science, Research and Innovation Strategy

VISION

The Marine Alliance for Science & Technology for Scotland (MASTS) will play an increasingly important role in fostering collaboration between its members to ensure that they benefit from being part of a nationally and internationally respected organisation. At a time of rapid global change, MASTS will provide a dynamic and flexible platform evolving to meet the needs of society. With research excellence at its core, MASTS will be outward facing and deliver solutions-based research and innovation with demonstrable impact for marine science, informing policy, regulation, industry and the general public. MASTS will seek to ensure that Scottish and UK marine science and training remains globally competitive.

CONTEXT

The MASTS Governing Council and Advisory Committee recommended that MASTS enhance its science, research and innovation strategy to guide future development. This strategic vision is based on an operational horizon of 5-10 years and a research and innovation horizon of 10 – 20 years and draws upon the current UK Industrial Strategy¹, and the Foresight Future of the Sea² and focuses on the need to deliver impact. The MASTS strategy is a living document, subject to regular review and development, providing a framework to guide our research community. The strategy will also be distilled into a public facing briefing document.

Scientific research excellence remains core to MASTS. However, this will increasingly embrace the associated impact generated from the “excellent application of science and research” to underpin “sustainable” economic performance, climate change adaptation, food, water, and energy security. Innovation will be required to address these challenges. An increasing awareness of the finite nature of natural resources and the capacity of the environment to sustain life will become an even more potent political and economic driver. There will be an increasing demand for “holistic” ecosystem-based approaches to managing the impact of human activities on the marine environment – acknowledging that humans are an integral part of that ecosystem.

1. GLOBAL MARINE RESEARCH CHALLENGES & DRIVERS

It is important to consider a MASTS strategy against the principal drivers of research and innovation, and associated funding over the next two decades. These scenarios do not exclude any research disciplines but, as the vast majority of research in the UK and Europe is publicly funded, Governments will focus resources on strategic issues, which all have implications for the marine environment.

POPULATION

An increasing need for resources - Population growth and economic development will inevitably increase pressure on coastal resources, challenging both the carrying and assimilative capacity of the environment. This will result in the extension of these impacts further offshore into deeper waters

¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/672468/uk-industrial-strategy-international-brochure-single-pages.pdf

² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/706956/foresight-future-of-the-sea-report.pdf

and remote, often uncharted areas. Energy, food and water security will rise up the political agenda in all countries. In developing countries with rapidly expanding populations, environmental concerns are likely to be tempered by the need to supply the growing population with shelter, food, water and energy at least cost. In addition, social stability will demand that job creation and industrial growth are prioritised to accommodate the number of people requiring employment.

Migrations - Climate change and poverty-induced migration will increase, placing significant economic, environmental and security burdens on neighbouring countries, particularly where a combination of geographic, political and economic factors amplify the migration.

Aging demographics - In developed countries with mature economies, a rapidly aging demographic will have a significant impact on economic performance, both directly as a result of increased costs of care and indirectly through reductions in the productive workforce. Governments in these countries will seek to address this through a combination of extending working life, increased automation, controlled immigration and maximising revenues derived from external investment growth.

Efficient use of available resources - Waste reduction, reduced consumption, and reuse and recycling will inevitably increase, together with pressure to find environmentally acceptable alternatives to materials such as plastics. The means, technology, institutions and infrastructure needed to effect this change will require research, innovation and major investment.

Societal drivers - Global change, population growth, demography, environmental degradation and lifestyle-related chronic health disorders will remain major societal, economic and political drivers over the next 20 years. Societally, “fairness” and “inclusion” are broad political concepts that marine science and innovation, whilst not necessarily addressing directly, will need to reflect. The United Nations Sustainable Development Goals (UN SDG 14 specifically) articulate many of the strategic drivers for marine science both nationally and internationally.

CLIMATE CHANGE

Sea level rise, coastal erosion and inundation will have a significant impact on coastal populations, including some of the world’s major cities. Increases in storm intensity and frequency together with increasing sea temperatures and the effects of ocean acidification and anoxia are likely to become more obvious with more direct impacts on the marine environment and dependant populations. Understanding, mitigating and adapting to climate change will become increasingly relevant in a marine context. Pressure on land-based resources will result in greater utilisation of marine systems to produce food and other raw materials that we currently derive from land-based agriculture.

FOOD SECURITY

Mariculture (marine based aquaculture) will expand significantly to meet the need for the efficient production of nutritious food for human consumption and animal feed. Mariculture may also serve as the basis for the production of other raw materials used in future manufacturing processes. There will be pressure to maximise production from the capture fishery although it is recognised that production has plateaued and the majority of food from the sea will have to come from mariculture.

ENERGY SECURITY

Energy security demands renewable alternatives that reduce CO₂ emissions dramatically. Political, economic and technical barriers constrain their development. However, reductions in the cost of offshore wind power, together with renewed focus on tidal stream power, suggests that marine renewable energy will expand over the next 20 years (particularly in Scotland).

Deployment of man-made structures in the sea will continue but, increasingly, these will be designed, *ab initio*, for ease of removal or retained for other sustainable uses. Whilst the offshore oil and gas sector in Scottish waters has probably plateaued it will still represent a significant economic focus over the next decades with ongoing research questions the MASTS community is well-placed to address.

NATURE'S CAPITAL & BIODIVERSITY

Understanding the finite nature of natural capital will be increasingly important in the marine environment. Ensuring decision makers are aware of the impact of their decisions on "systems", which by default include humans, will require new ways of delivering complex information and securing behavioural change in the way humans interact with and value their environment. Research must be part of this decision-making, recognising that we have limited ability to "manage" the environment, but that we can try to manage people.

MARINE SECTORS – SHIPPING, MINERALS and TOURISM

Shipping activity will increase to transport greater volumes of goods. Climate change induced reductions in polar ice coverage, particularly in the Arctic, will open up new shipping routes and may favour new harbour development. Increasing shipping activity will lead to higher risk of chronic environmental impacts and pollution incidents in these regions.

Minerals - Pressure to secure raw materials, such as deep sea mineral deposits, marine hydrates and remaining fossil fuel deposits, will increase in some countries, particularly where they seek to retain or establish regional geopolitical and economic power.

Coastal tourism will increase significantly as a result of increasing wealth in populous countries with expanding economies. Whilst economically beneficial, the impacts of mass tourism in coastal areas on scales not thus far experienced will need to be addressed. Increasingly, a niche market in "eco-tourism" has developed, often focused on marine and coastal habitats. This tourism sector requires sound and timely ecosystem-based managerial advice to avoid over-exploitation.

The MASTS science community will develop expertise to understand the opportunities and challenges these sectors present. Whilst many are relevant to Scotland, they will all have increasing international significance and our ability to influence decisions and contribute to more sustainable economic activity will hinge upon having a credible scientific base.

COUPLED GOVERNANCE & OBSERVING SYSTEMS

Europe's far reaching legislation, such as the Marine Strategy Framework Directive, coupled to indicators of Good Environmental Status, and the Marine Planning Directive, will be significant drivers of research. Brexit (29 March 2019) will also stimulate calls for changes in legislation and policy that will need to be underpinned by science. Sea and ocean areas beyond national jurisdiction will come under increasing pressure for exploitation of their natural resources – fisheries and mineral exploitation, in particular. Political and legal processes will need to be accelerated and appropriate means of monitoring and enforcement developed.

The pressures on the marine environment will demand better Governance, stronger institutions, and dynamic regulation and management. These structures will require access to relevant integrated information and knowledge derived from a range of disciplines. Much of this data will need to be generated from automated collection of remotely sensed data. Robotics and artificial intelligence applications hail a step change in our ability to undertake marine research at lower cost and in hitherto inaccessible areas. The miniaturisation, automation and reducing cost of many biomolecular technologies will also open up a range of novel sensing capability.

EXPANDING THE MARINE KNOWLEDGE BASE

Our fundamental understanding of marine processes and systems is growing, but lags behind our terrestrial knowledge. Addressing core marine challenges will require targeted investment and capacity building in fundamental areas that remain far from market. Curiosity driven research judged and funded on excellence, needs to be prioritised in areas where least is known about the marine environment and where there is highest risk of damage or loss as a result of anthropogenic activity.

2. MASTS RESPONSE - A RESILIENT PARTNERSHIP

The challenges outlined provide strategic focus for the MASTS community to build upon its established collaborative relationships and networks required for interdisciplinary “solutions based” research.

Scotland can lead the way and challenge conventional models of academic progress and reward, going beyond classical institutional boundaries and barriers to build world leading cross-disciplinary teams. In some respects, MASTS has managed to foster this ethos already, but given the scale, complexity and cost of addressing some of the emerging challenges, it is not realistic to assume that the future will simply represent a continuation of the past. Rapid, dynamic and disruptive change will be a feature of the next 20 years and organisations such as MASTS can provide a platform to allow its members to adapt and capitalise on opportunities that arise in response to predicted changes. To achieve this vision, additional resources will be required, predicated on dynamic, responsive and flexible management rather than fixed staff complements and rigid institutional structures.

NATIONAL

MASTS operates within a broad research landscape, ranging from fundamental science to applied research, designed to underpin policy, regulation and industry. MASTS is recognised by Government as a source of expertise and research capacity, through its Forums and facilitated by direct Membership of Government bodies and the National Oceanography Centre Association. At the Scottish level, MASTS interacts with an extensive network of public and private organisations. It collaborates directly with other research pools, such as the Scottish Alliance for Geoscience and Environment and Society (SAGES) and Scottish Universities Life Sciences Alliance (SULSA), the Innovation Centres, Scottish Natural Heritage (SNH), Scottish Environment Protection Agency (SEPA), Marine Scotland Science (MSS) and Joint Nature Conservation Committee (JNCC).

INTERNATIONAL

MASTS actively collaborates with partners at EU level through representation on a number of strategic groups and organisations, including the Marine Strategy Forum, Marine Science Co-ordination Committee, European Marine Board and the European Marine Biological Resource Centre. In addition, MAST-Scotland has signed Memoranda of Understanding (MoUs) with international organisations.

MASTS STRATEGY

MASTS is well-placed, particularly in a Scottish/UK context, to respond to the future research drivers that are emerging. Growing and supporting capacity in these areas is of strategic importance and Government, together with private investment, should be encouraged to focus on these areas.

MASTS supports a diverse and internationally competitive marine research community; aligning and integrating this capacity will be key to growing this reputation. Our member institutions need to be recognised as destinations of choice for world-leading researchers and the brightest students. Developing an enhanced collaborative, collegiate and co-ordinated approach at national level will foster such recognition. The development of new functional groups within the research “ecosystem”

which fully recognise and focus on the delivery of solutions will be central to the delivery of the overall MASTS mission. Whilst this will require changes in the way we interact, the dividends in terms of scientific progress and innovation will be significant.

MASTS will continue to develop its reputation as the UK's premier marine research consortium, maintaining and exploiting its relationships at national, UK, European and global level. This will ensure that the MASTS community remains visible and has the power to influence decision making relevant to future research funding, as well as promoting the vision of clean, healthy, safe, productive and biologically diverse oceans and seas.

MASTS Objectives and Commitments as Part of a Resilient Partnership

- Continued membership of the European Marine Board (EMB) and the European Marine Biological Resource Centre (EMBRC), subject to annual review.
- Maintain membership of the Marine Strategy Forum but play a more active role – providing at least one MASTS highlight report to the Forum annually.
- Contribute to the development of the Scottish Marine Science Strategy.
- Contribute to the EMB strategy – Navigating the Future V.
- Seek to support and embed MASTS representatives on relevant UK Government “missions” abroad.
- Seek further meaningful MoUs with related organisations globally.
- Inform the research agendas of Government and funding organisations with respect to addressing strategic challenges through continued high-level engagement and representation.
- MASTS will produce high impact position papers to refine research requirements to address the emerging challenges. The Forum structure and cross-disciplinary workshops will develop a series of succinct research requirements documents to inform funding bodies and decision makers.
- Working with the other research pools, Innovation Centres and the Scottish Funding Council, we will explore mechanisms to reduce barriers to the recruitment of early career researchers.
- Offering unparalleled opportunities to early career researchers should become a hallmark of MASTS – encouraging new ideas and new ways of working.
- MASTS will champion a series of integrated workshops to promote “ecosystem” approaches to research designed to bring researchers and practitioners from different disciplines together and establish networks that will enhance the potential for developing successful funding applications.

3. MASTS SCIENCE & STRUCTURES

MASTS strategy will be based on past success with flexibility to respond to future challenges. The overarching Theme and Forum structure will be retained, and more cross-Forum activity and communication encouraged. Further resources are needed to increase the capacity of Forums to become more effective and responsive to opportunities to interact with non-academic agendas, such as requests to contribute expertise and knowledge to consultations, international working groups and businesses. This will become increasingly important post-Brexit and Government should ensure that the Scottish/UK position is supported with robust science. MASTS will seek to secure resources to expand its outreach capacity with a view to participating in high impact events. The UN Decade of Ocean Science (2021 – 2030) will provide an important catalyst for raising the profile of marine science, and the MASTS community must capitalise on this opportunity.

As of 2018, MASTS has 17 Member organisations consisting of 11 Higher Education Institutions and 6 Non-HEIs, including Government bodies and a private charity. MASTS continues to raise the profile of its research community wherever possible and particularly at domestic and international

governmental level. We also support targeted outreach activities delivered by MASTS members. The Annual Science Meeting represents a major point of contact between stakeholders with approximately 50% of attendees (cf. 450) being from outside of academia.

The original MASTS Science Structure was founded upon the UK and Scottish Marine Science Strategies of which MASTS is a named party. The UK Administrations share a common vision of having “clean, healthy, safe, productive and biologically diverse oceans and seas”. Joint adoption of a UK Marine Policy Statement provides a high-level policy context for the development of marine plans across the UK. However, this vision is also globally applicable, as are the implications for the marine science required to inform and underpin it.

From this national and international high-level vision, MASTS defined three Themes:

- Dynamics and properties of marine systems;
- Productive seas; and
- Biodiversity, ecosystem function and services.

Under these themes, related cognate Forums have been forged by the research community and designed to be flexible and responsive in terms of the nature of the research and the community they engage. They are led by an elected Convenor and a Steering Group, with policy, regulatory and industry members, charged with engaging the relevant MASTS research community to:

- i. Improve communication;
- ii. Increase collaboration;
- iii. Develop areas of research that may be taken forward collectively;
- iv. Influence funding; and
- v. Develop and enhance impact and outreach.

MASTS Objectives and Commitments as Part of its Science Structure

1. Review Forums annually and assess their performance.
2. Foster, promote and facilitate opportunities to deliver impact through science excellence coupled to strong working relationships with Government, regulators and industry.
3. Grow the number of individual researchers working with MASTS Forums across all members.
4. Seek to align its Science Structure to a rapidly changing scientific and political landscape by encouraging and facilitating Forums to be engaged in influencing the decision-making processes.
5. Secure additional resources to support significant outreach activity designed to promote and increase the impact of marine science.
6. By addressing the needs of its members, ensure the continuity of members’ contributions to the operational costs of MASTS and its legal entity MAST-Scotland to ensure that the Science Structure is appropriately resourced.
7. Based on the expertise vested in the MASTS Science Structure, engage with Scottish Government and the Scottish Funding Council to secure additional funding to support Scottish marine science and expert representation in key international fora.

4. MASTS - LEADERSHIP IN RESEARCHER TRAINING AND SKILLS DEVELOPMENT

The **MASTS Graduate School** is an integral part of our strategy. This body includes co-supervision of PhD students by a minimum of two member HEIs, the potential for joint registration of students and an active training programme now embodied in an innovative Postgraduate Certificate in Researcher Professional Development (PG Cert.). This will ensure that the Graduate School demonstrably builds

capacity for the provision of highly trained researchers with transferable skill sets and expertise required by a range of employers.

Whilst MASTS, under the wider umbrella of “The Scottish Universities Partnership for Environmental Research” (SUPER), has now become a NERC-funded Doctoral Training Partnership (DTP), MASTS will continue to develop its Graduate School through a mixed funding portfolio.

Government has recognised the need to offer training opportunities other than Degrees to meet the needs of the jobs market. It is possible that a similar analysis of higher degrees, MSc and PhD programmes, might lead to changes in funding priorities and focus. Given that a significant proportion of graduates and higher degree level students do not continue in research, the return to society as a result of these awards is likely to be scrutinised³. Either the nature of the training implicit in the award may change to reflect societal needs or the numbers being trained could ultimately decline through lack of funding and a desire to invest in training which results in employment or levels of compensation commensurate with the cost of the qualification.

MASTS should anticipate this trend by continuing to actively develop “T-shaped” PhD students that have outstanding ability and a range of transferrable cross-disciplinary skills that set them apart from other graduates. In addition, MASTS should facilitate the development of each student’s network to maximise their intellectual and professional opportunities.

MASTS Objectives and Commitments for Leadership in Researcher Training and Skills Development

1. Secure 6 PhD studentships per year.
2. Continue to develop the PG Cert. whilst offering new contributing course units.
3. Undertake one major student retreat per year attended by 50% of the graduate student cohort.
4. Undertake an annual student session/event at the MASTS Annual Science Meeting.
5. Offer at least two small grant rounds per year – directed towards student applicants.
6. Encourage at least two student-led training initiatives per year.
7. Appoint at least one student representative on all Forums.
8. Support at least three internships per year.
9. Establish a more formal alumni group and progression tracking process.
10. Develop the SUPER DTP and integrate, where possible, with the MASTS Graduate School.

5. EXPANDING MASTS MEMBERSHIP

MASTS will first seek to ensure that its existing members are well served as part of a well co-ordinated marine research consortium. Where appropriate, MASTS will encourage additional members that complement and add value to the existing consortium.

MASTS Objectives and Commitments Actions for Expanding Membership

- MASTS will expand its membership by promoting the consortium to appropriate new members with a view to adding at least one new member (on average) every two years.
- More flexible options for membership will be explored to accommodate industry and NGO membership where this is considered to be advantageous to MASTS.

³ <https://publications.parliament.uk/pa/cm201719/cmselect/cmeduc/343/34302.htm>

6. SHIFTING TIDES IN MARINE GEOPOLITICS & EMERGING INNOVATION

It is inevitable that both the UK and the EU will continue to use science as a part of “soft” political and economic diplomacy to win favour and influence internationally. Over the last five years, the UK has allocated significant funding under the banner of “Global Challenges” articulated through the UN SDGs to develop relationships with OECD, ODA-listed countries – with a particular interest in those with emerging economies of strategic interest. This trend is likely to continue with increasing pressure to convert “collaborative” relationships into more concrete trading partnerships.

For example, in December 2017, the *United Nations* announced the *Decade of Ocean Science for Sustainable Development (2021-2030)*⁴ to mobilize the scientific community, policy-makers, business and civil society around a programme of joint research and technological innovation. The *Decade* is to be led by the International Oceanographic Commission (IOC), which is currently developing a strategy. Although there are no specific funds identified for this initiative, MASTS should seek resources for a series of defined initiatives on the assumption that it will continue to function beyond 2022. The *Decade* represents an unprecedented opportunity to raise the profile of marine science and the marine environment and it aligns with UK policy to address UN Strategic Development Goals.

MASTS has been successfully recognised by UK Government as a representative body for marine science and has been invited to participate in a number of high profile “missions” to encourage international collaboration. This status is likely to continue but it is imperative that a more co-ordinated, focused and professional approach is adopted. MASTS is actively advocating this. However, MASTS together with the relevant Innovation Centres should proactively seek to address deficiencies in national approaches and thereby place itself at an advantage in developing future international partnerships. MASTS should also seek to engage internationally on an independent basis by securing funds to facilitate exchanges, collaborations and studentships.

Whilst espousing the virtue of multidisciplinary, interdisciplinary and impactful research, few funding opportunities actually foster this activity on sufficient scale or over sufficient timescales to deliver tangible results. Funding still tends to exist in silos and fails to focus on problem solving and innovation that result in economic benefit. We must go beyond “technology transfer” and “knowledge exchange” as fashionable epithets for academic research translation into economic benefit. We should redouble efforts to move relevant research innovation to commercialisation. Scotland has funded Innovation Centres (ICs) whose purpose is to foster innovation and link academia with industry to help streamline and accelerate the commercialisation of innovation. However, from an academic perspective, there is relatively little recognition or professional merit derived from contributing to the development of policy, regulation or commerce, as the outputs are less tangible and often take an extended time to materialise. The systems and processes of reward within academia can be a barrier to commercially oriented innovation.

MASTS will continue to make representations to Scottish Government, the Scottish Funding Council, Research Councils UK and the Department for Business, Innovation and Economic Strategy to push for targeted changes in both funding and academic reward that encourages research and innovation that translates into economic benefit. MASTS will pursue a closer relationship with the Innovation Centres and directly with industry to encourage collaboration and investment.

⁴ <https://en.unesco.org/ocean-decade>

MASTS Objectives and Commitments for Addressing Shifting Tides

- Engage with the relevant ICs to augment the MASTS PG Cert., offering relevant courses and to facilitate internships with industry (one internship per IC per year).
- Engage the ICs, Government and industry in applications for funding (one per year).
- Facilitate the development of impact case studies for the Research Excellence Framework (as required).
- Forums will be encouraged to engage with the innovation agenda and openly address innovation opportunities and challenges as part of their remit to demonstrate impact.
- In collaboration with relevant ICs, and research pools, MASTS will attempt to secure resources to develop generic promotional materials suitable for distribution at international events/meetings.
- Seek to embed appropriate MASTS representatives on all relevant UK Government-led initiatives to establish international collaborations.
- Under the SUPER DTP bid, we will seek to secure co-funded international studentships.
- In response to the emerging IOC programme for the *Decade of the Oceans*, develop initiatives that will capitalise on the higher profile for the marine environment that this *Decade* will bring.

7. SUSTAINABILITY

MASTS financial sustainability is contingent upon core funding from the Scottish Funding Council (SFC) together with additional contributions from its members that, at least, match the SFC annual commitment. These funds cover the operational costs including the MASTS Directorate, the Graduate School, networking funds, small grant schemes and membership fees for the EMB and EMBRC. Although subject to annual review, the current commitment appears stable until 2022. MASTS legal and charitable entity MAST-Scotland provides additional legal and financial flexibility to engage in collective agreements with third parties ranging from MoUs to fully contracted partnerships and projects. The MASTS Directorate also generates income through projects to offset the operational costs of MASTS and increase the funds available to support MASTS activities.

MASTS recognises the need to deliver services to its members commensurate with funds committed. The long-term sustainability of MASTS will depend upon meeting the objectives and commitments, identified in this strategy. To expand its current level of activity, MASTS would require more resources (funds and staff). To maintain the same level of activity in the absence of SFC funding would not be possible without replacement funding from other sources, such as the existing membership and potentially an expanded membership. The existing members are unlikely to increase their agreed contributions to MASTS. Expanding MASTS membership is possible, particularly with respect to expanding non-HEI membership, but this will need to be tempered by the additional expectations of these members as a function of “return on investment”.

MASTS’s strength as an organisation is derived from the active participation of members at both institutional and individual staff levels. We will continue to encourage participation through our Forums and related network activities. We will continue to engage with the marine science stakeholders in the broadest sense to encourage community development and identity, which sets MASTS apart from other organisations. Building and promoting the MASTS “brand” has been successful and we need to continue this process at national and international level. Maintaining existing and forging new strategic partnerships particularly with relevant ICs, regulators, industry and international organisations will be key to MASTS success post-Brexit. Securing additional funding from a range of public and private sources needs to be explored in a more structured manner with a view to identifying support for specific initiatives and events. MASTS must retain a flexible and agile

structure and representational roles will need to be reviewed in anticipation of significant changes, particularly over the next three to five years.

MASTS Objectives and Commitments to Deliver Sustainability

In addition to the objectives and commitments defined under Expanding MASTS Membership, MASTS will:

- Expand relationships with the ICs, regulators, industry and international organisations – documenting these relationships as part of its annual reporting process.
- Develop a more structured approach to identifying and securing additional funding.
- Expand activities that engage the widest possible spectrum of MASTS stakeholders.

8. CHALLENGES AND OPPORTUNITIES

Strengths – MASTS effectively facilitates marine research in Scotland and is respected and recognised both nationally and internationally. By fostering a sense of community MASTS now engages academic researchers with policy, regulators and industry. Through its Graduate School it has built scientific capacity. MASTS success has encouraged significant additional infrastructure investment in marine science in Scotland. It is relatively financially stable.

Weaknesses – MASTS is still reliant upon core funding from the Scottish Funding Council (currently under review). The loss of these funds could cause the organisation to fail. MASTS relies heavily upon the in-kind contribution of time from dedicated scientists who actively engage in MASTS Governance and science structure.

Opportunities – MASTS has the critical mass, resources and cohesion to deliver impact on a scale that is meaningful scientifically, societally and economically. No other marine science consortium in Europe has the capacity and reach of MASTS. With improved co-ordination and access to modest resources, MASTS has the potential to help develop the UK's and Scotland's global presence in marine science.

Threats – Short-term threats are almost exclusively related to Brexit and the uncertainty associated with funding, access to and retention of scientific talent. In addition, MASTS, through its members and Scottish Government, needs to consider how its capacity can be increased to meet the demands of an expanding workload on relatively few core staff.

Summary of MASTS Key Performance Indicators (2019-2022)

- Membership of the European Marine Board (EMB) and the European Marine Biological Resource Centre (EMBR) until 2022 (subject to annual review).
- Contribute to the development of the Scottish Marine Science Strategy (evidenced by acknowledgment) and provide an annual highlight report to the Marine Strategy Forum.
- Expand relationships with the ICs, regulators, industry and international organisations (evidenced by annual reporting process and new industry partners).
- Produce high impact position papers to refine research requirements (2 per annum).
- Undertake one major student retreat per year attended by 50% of the graduate student cohort (evidenced by participation figures).
- Undertake an annual student session/event at the MASTS Annual Science Meeting.
- Appoint a student representative on all Forums (evidenced by forum committee structures).
- Secure 6 PhD studentships per year (evidenced by MAST Graduate School numbers).
- Contribute to the EMB strategy – Navigating the Future V (evidenced by acknowledgement).
- Review Forums annually to assess performance (evidenced by annual reporting process).
- Champion annual integrated workshops to promote “ecosystem” approaches to research designed to bring researchers and practitioners from different disciplines together.
- Offer two small grant rounds per year – directed towards doctoral student applicants.
- Support at least three doctoral student internships per year.
- Expand membership by promoting the consortium to appropriate new members with a view to adding at least one new member (on average) every two years.
- Engage with the relevant ICs to augment the MASTS PG Cert., offering relevant courses and to facilitate internships with industry (one internship per IC per year).
- Engage the ICs, Government and industry in applications for funding (one per year).
- Grow the number of researchers working with MASTS Forums (assessed by membership lists).
- Encourage at least two student-led training initiatives per year.
- Establish a more formal alumni group and progression tracking process.
- Secure additional resources to support significant outreach activity designed to promote and increase the impact of marine science (~£20K per annum).