NELSON MANDELA UNIVERSITY

Report on Ocean Sciences Governance and Management Model

Compiled by Professor Heather Nel assisted by the Ocean Sciences Project Office

Revised and updated
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Ocean Sciences Governance and Management Model

EXECUTIVE SUMMARY

Nelson Mandela University aspires to be a destination of choice for ocean sciences nationally and on the African continent. To this end, a comprehensive five-year ocean sciences strategy (2021-2025) is being developed, as informed by the contributions of various faculties, research chairs and entities. The purpose of this report is to outline high-level recommendations in respect of the key dimensions of this strategy including, but not limited to, the design of an ocean sciences governance and management model that facilitates inter- and transdisciplinary collaboration internally and externally.

The University's overarching five-year ocean sciences strategy will aim to achieve various broad objectives, namely, to:

- Scale up current and potential ocean sciences **academic programme and qualification offerings** through incremental adaptations to existing programmes, qualifications and modules, as well as developing distinctive *de novo* qualifications at under- and postgraduate levels across all faculties.
- Develop short learning programmes (SLPs) offered through flexible modes of delivery that respond to the **continuing professional/executive development** needs of various sectors of the oceans economy locally, regionally, nationally, on the African continent and globally.
- Harness inter- and transdisciplinary **research and innovation** strengths and capabilities aligned with ocean sciences thematic areas that contribute to addressing global sustainability challenges confronting our oceans.
- Promote extensive and ongoing **engagement and collaboration** with relevant ocean sciences stakeholders to forge mutually beneficial quadruple helix partnerships with civil society, industry, government and other post-school educational institutions nationally and internationally.
- Develop a **resourcing model** that promotes the long-term sustainability and responsiveness of the Ocean Sciences Campus as it seeks to advance inter- and transdisciplinary learning, scholarship, innovation and engagement.

Furthermore, the ocean sciences strategy is informed by various **overarching principles** to position Mandela University in the service of society. These principles have evolved over time and include the following, namely, to:

- Holistically promote environmental, social and economic **sustainability** to unlock the economic potential of South Africa's oceans for the benefit of local communities while conserving marine biodiversity and ecological integrity.
- Give practical expression to the University's **African identity and rootedness** ranging from African-purposed curricula and research endeavours, to expanding the geographical footprint of collaborative partnerships across the African continent and embracing a spatial design philosophy and aesthetic that foregrounds the richness of Africa's coastal cultures and oceanic biodiversity.

- Leverage the University's competitive advantage as a comprehensive university by harnessing pioneering, boundary-spanning **inter- and transdisciplinary synergies** across a wide range of disciplines in all faculties.
- Sustain a network of **quadruple-helix partnerships** at local, regional, national, continental, and global levels.
- Create a **conducive ecosystem for convergence** or dedicated physical and intellectual spaces where staff and students can come together to co-create knowledge that addresses multi-faceted sustainability challenges confronting our oceans.
- Promote a **national maritime consciousness** that inspires the next generation of talented youth to pursue ocean sciences qualifications and careers while also creating broad-based awareness of the need to protect marine resources and biodiversity.
- Embrace a **hub and spoke model**, whereby the Ocean Sciences Campus is one of seven University campuses, which serves as a "hub" for transdisciplinary ocean sciences postgraduate studies, research and innovation. This complements the undergraduate ocean sciences offerings located on the other six campuses in Port Elizabeth and George, as well as various other off-campus facilities and research sites.
- Design **multi-purpose spatial precincts** that facilitate the co-location of academics, research chairs, entities, postgraduate students, postdoctoral fellows and partners in alignment with transdisciplinary ocean sciences thematic areas.
- Experiment with innovative approaches to **integrated service delivery** and thereby reduce duplication, optimise synergies, and enhance efficiency and cost-effectiveness.

During the first two quarters of 2020, the Ocean Sciences Project Office conducted **extensive engagements** with Deputy Vice-Chancellors, Executive Deans and selected international partners to inform the development of a five-year (2020-2025) ocean sciences strategy as an integral part of Nelson Mandela University's Vision 2030 strategic plan. These consultations yielded rich insights and ideas, which are outlined in this report to inform the University's future strategic trajectory in respect of cutting-edge, inter- and transdisciplinary ocean sciences academic programmes and qualifications, research, innovation, international partnerships, engagement and resourcing model.

Furthermore, a **benchmarking** exercise was undertaken of selected international universities to design a fit-for-purpose Ocean Sciences governance and management model, including some initial proposals for a resourcing model that promotes university-wide collaboration and synergies. The scope of the benchmarking was limited to ocean sciences (or other) institutes at reputable universities with whom Mandela University has established partnerships and/or collaborative projects, including:

- Institute of Marine Research (IMR) (Norway);
- Norwegian University of Science and Technology (NTNU) Oceans;
- Southampton Marine and Maritime Institute, University of Southampton;
- Marine Institute, University of Plymouth;
- Oceans Institute, Western Australia;
- Australian Maritime College, Australia; and
- National Research Foundation Ithemba Labs, South Africa.

Extensive **desktop research** was also conducted to assess the institutional conditions required to establish an adaptive ocean sciences governance and management model that is conducive to inter- and transdisciplinary integration across multiple organisational domains and levels. This research informed various recommendations outlined in the final section of the report in respect of the proposed ocean sciences governance and management model.

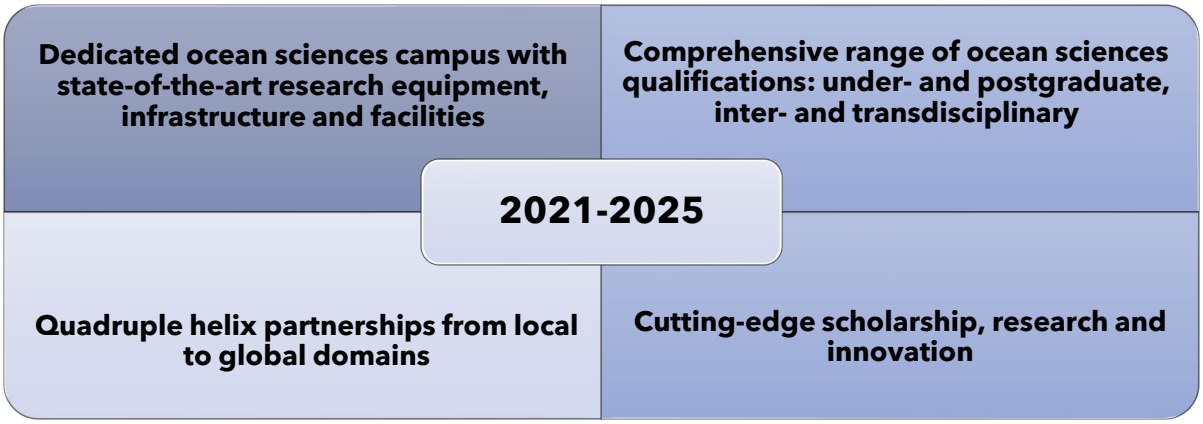
1. INTRODUCTION

In pursuit of its vision to be a dynamic, African university that is recognised for its leadership in generating cutting-edge knowledge for a sustainable future, Nelson Mandela University aspires to be a destination of choice for ocean sciences on the African continent. To this end, a comprehensive five-year ocean sciences strategy (2021-2025) is being developed, as informed by the contributions of various faculties, research chairs and entities.

This overarching five-year strategy will aim to achieve the following broad objectives, namely to:

- Scale up current and potential ocean sciences academic offerings through incremental adaptations to existing programmes, qualifications and modules, as well as developing *de novo* qualifications at under- and postgraduate levels across all faculties.
- Develop short learning programmes (SLPs) that respond to the continuing professional development needs of various sectors of the oceans economy locally, regionally, nationally, on the African continent and globally.
- Harness inter- and transdisciplinary research and innovation strengths and capabilities aligned with ocean sciences thematic areas that contribute to addressing global sustainability challenges confronting our oceans.
- Promote extensive and ongoing engagement with relevant ocean sciences stakeholders to forge mutually beneficial quadruple helix partnerships with civil society, industry, government and other post-school educational institutions nationally and internationally.
- Develop a resourcing model that promotes the long-term sustainability and responsiveness of the University as it seeks to advance inter- and transdisciplinary ocean sciences scholarship and engagement.

The key pillars of the ocean sciences strategy and programmatic interventions are outlined in the diagram below:



In support of the strategy, the University is in the process of designing an ocean sciences governance and management model and a phased resourcing and infrastructural development plan. This will ensure that the ocean sciences academic offerings are underpinned by a realistic assessment of the resources required in positioning the University as a leading ocean sciences university on the African continent. To date, this has been bolstered through infrastructure, equipment and related funding support received from government, industry and other partners to refurbish and equip the first dedicated Ocean Sciences Campus in South Africa.

2. PURPOSE OF REPORT

During April and May 2020, the Ocean Sciences Project Office engaged extensively with Deputy Vice-Chancellors, Executive Deans and selected international partners to inform the development of a five-year (2020-2025) ocean sciences strategy as an integral part of Nelson Mandela University's Vision 2030 strategic plan. The engagements conducted are outlined below:

Internal stakeholders:

- Deputy Vice-Chancellor Learning and Teaching (Prof Cheryl Foxcroft);
- Deputy Vice-Chancellor: Research, Innovation and Internationalisation (Dr Thandi Mgwebi);
- Deputy Vice Chancellor: People and Operations (Mr Lebogang Hashatse);
- Executive Dean: Business and Economic Sciences (Prof Hendrik Lloyd);
- Acting Executive Dean: Education (Prof Nokhanyo Mdzanga);
- Executive Dean: Engineering, Built Environment and Technology (Prof Barend van Wyk);
- Executive Dean: Health Sciences (Prof Lungile Pepeta);
- Acting Executive Dean: Humanities (Prof Mary Duker);
- Executive Dean: Law (Prof Avinash Govindjee); and
- Executive Dean: Science (Prof Azwinndini Muronga).

International partners:

- Professor Rachel Mills, Professor in Ocean and Earth Science and Dean of the Faculty of Environmental and Life Sciences, University of Southampton;
- Professor Damon Teagle, Professor of Geochemistry in the School of Ocean and Earth Science and Director of the Southampton Marine and Maritime Institute, University of Southampton; and
- Professor Richard Thompson, Director of the Marine Institute, Plymouth University.

These consultations yielded rich insights and ideas, which are outlined in this report to inform the University's future trajectory in respect of cutting-edge, inter- and transdisciplinary ocean sciences academic programmes and qualifications, research, innovation, international partnerships, engagement and resource mobilisation strategies. Furthermore, a desktop benchmarking exercise was undertaken of selected international universities to design a fit-for-purpose ocean sciences governance and management model that promotes university-wide collaboration and synergies, to underpin the University's five-year ocean sciences strategy.

Over time, various foundational principles have emerged in respect of the University's ocean sciences strategy and institutional arrangements, which are outlined below as a point of departure.

3. PRINCIPLES INFORMING THE OCEAN SCIENCES STRATEGY AT NELSON MANDELA UNIVERSITY

The implementation of the University's ocean sciences strategy continues to be informed by various design principles to ensure that it is aligned to the vision to be a dynamic, African university recognised for its leadership in generating cutting-edge knowledge for a sustainable future. Importantly, the focus of the strategy spans the three spheres of **sustainability**, i.e. environmental, social and economic. In this way, the University aims to contribute to national, provincial and local efforts to unlock the economic potential of South Africa's oceans for the benefit of local communities while conserving marine biodiversity and ecological integrity. At the same time, the health of our oceans, particularly the Indian and Southern Oceans and Antartica, is crucial not only for human social and economic security, but also to climate stability and sustainability of planetary biodiversity. In this regard, the nexus between ocean health, biodiversity and climate stability is of critical concern.

This is in alignment with the United Nations 2030 Sustainable Development Goals, in particular Goal 14, which aims to *"Conserve and sustainably use the oceans, seas and marine resources for sustainable development"*. The expansion of protected areas for marine biodiversity and existing policies and treaties that encourage responsible use of ocean resources are still insufficient to combat the adverse effects of overfishing and ocean acidification due to climate change. The UN correctly notes that billions of people depend on oceans for their livelihood and food security and given the transboundary nature of

oceans, increased efforts and interventions are needed to conserve and sustainably use ocean resources at all levels.

Now more than ever before, universities in Africa are expected to contribute to the public good and address the developmental needs of the continent through active civic engagement and social responsiveness. One of the key priorities of the African Union Agenda 2063 is to aspire towards *"A Prosperous Africa, based on Inclusive Growth and Sustainable Development"* and this requires a dedicated focus on addressing persistent, real-world challenges facing the continent such as food security, resource scarcity, global change, conflict, poverty, rapid urbanisation and the burden of disease. To this end, Goal 6 of Agenda 2063 prioritises the blue/ocean economy for accelerated economic growth with a particular focus on marine resources and energy, as well as ports operations and marine transport.

In alignment with the continental developmental agenda, the University embraces efforts to give practical expression to its **African identity and rootedness** whilst remaining an integral part of an increasingly inter-connected global community of scholars**.** This agenda involves the promotion of innovative African-purposed curricula, learning and teaching and forms of social engagement that draw on the rich cultural diversity and biodiversity of Africa's coastline and oceans and our unique geographical location.

Against this background, it is of paramount importance that Nelson Mandela University positions itself strategically in the service of society, primarily through its core mandates of teaching, learning, research, and engagement. The University seeks to contribute to advancing a socially just, humane, and sustainable world through pursuing the following **strategic priorities**, namely, to:

- Embrace a distinctive educational purpose and philosophy that contributes to student access and success;
- Develop and cultivate an engaged, innovative scholarship culture that generates knowledge recognised for its contribution to sustainability;
- Foster an affirming, transformative institutional culture that promotes diversity and social cohesion;
- Enhance long-term financial sustainability through innovative resource mobilisation and responsible stewardship;
- Position the University as an employer of first choice by investing in talented, high-performing staff; and
- Provide and sustain enabling systems and infrastructure that promote an exceptional experience for students, staff and key stakeholders.

In pursuing these strategic priorities, the University strives to expand the frontiers of knowledge and cultivate graduates who make a positive impact on society through embodying attributes such as critical thinking, innovative and entrepreneurial mindsets, adaptive expertise, social consciousness and awareness, and creativity. As one of six comprehensive universities in South Africa, Mandela University seeks to harness the contribution of a wide range of disciplines from certificate to doctoral levels to facilitate

inter- and transdisciplinarity. There is growing awareness that multiple, rather than singular, viewpoints are best suited to address "wicked problems", which are difficult to define, involve multiple actors, are socially and politically complex, and have no clear solution (Peters, 2017: 386; Miller, 2016: 45). In addressing interconnected societal issues, transdisciplinarity moves beyond the bridging of disciplinary divides within the University, to harness the generative and integrative potential of harnessing the knowledge of disciplinary experts, students and external communities in co-creating socially responsive solutions to persistent, intractable challenges.

The sustainable solution to global and local challenges in pursuit of the public good, lies in the collective sense making and a shared understanding of possible solutions through *"…a process that integrates a variety of disciplines and actors from public agencies, civil society and the private sector."* (Pohl & Hirsch Hadorn, 2007: 16). As such, the university is no longer the single source of knowledge and expertise but constitutes a node within a network of **quadruple-helix partnerships**, spanning local, regional, national, continental, and global domains. The quadruple helix model is an enhancement of the triple helix perspective that not only focuses on the actors from academia, government, and industry, but also recognises civil society and local communities as important stakeholders. The relationships between the actors are the context for achieving value-creating outcomes that none of the parties could have achieved alone (Hasche, Höglund & Linton, 2019: 3-5).

This aligns well with the intentions of Mandela University to position itself as a transformative, responsive university where engagement is conceptualised as **convergence** (Muthwa, 2018) or the coming-together of university and community to co-create knowledge through *"…real-life programmes that make a difference to ordinary people"* (Willemse, 2019).

The infrastructural development and spatial plan for the Ocean Sciences Campus ensures that current and future developments progressively build towards creating a **conducive ecosystem for convergence** or dedicated physical spaces where university staff and students can come together with local communities, government and industry to address multi-faceted sustainability challenges. The planning for the construction of a new ocean science centre makes provision for a 150-seater auditorium, state-of-the-art digital planetarium/aquarium and immersive visualisation technology. The University will make use of this and other facilities on the campus to host public lectures, seminars and conferences, conduct research, and reach out to schools and colleges throughout South Africa to promote a **national maritime consciousness** and inspire the next generation of young scientists to pursue ocean sciences qualifications and careers.

A further principle embedded in the University's ocean sciences strategy is the **hub and spoke model**, where the Ocean Sciences Campus is one of seven campuses of Nelson Mandela University and serves as a "hub" for transdisciplinary ocean sciences postgraduate studies, research and innovation. This complements the undergraduate ocean sciences offerings located on the other six campuses in Port Elizabeth and George, as well as the research and engagement undertaken by faculties at various other facilities and sites across

the city such as the ports, industrial development zones, the Cape Recife conservancy, Algoa Bay, Sundays River and beyond. In this way, the phased development of the Ocean Sciences Campus to establish it as a centre of excellence will not denude the resource capabilities and assets already available on other campuses.

Through the co-location of academics, research chairs, postgraduate students, research and engagement entities, and postdoctoral fellows in **spatial precincts** on the Ocean Sciences Campus, the University will intentionally foster pioneering, boundary-spanning postgraduate studies, research, innovation and engagement across all faculties. Furthermore, the University will experiment with the flexible design of **multi-purpose spaces** and innovative approaches to **integrated service delivery** by establishing a centrally accessible hub to provide transversal support on the campus thereby reducing duplication, optimising synergies, and enhancing efficiencies.

The principles articulated above inform the updated ocean sciences strategy for 2021 to 2025, including the design of an ocean sciences governance and management model that facilitates inter- and transdisciplinarity and interfaces optimally with the governance and management arrangements of faculties, entities, research chairs, and relevant support service portfolios. In the interim, the University has established transitional institutional planning arrangements to manage the Ocean Sciences Campus and these are briefly outlined in the next section.

4. INTERIM INSTITUTIONAL PLANNING ARRANGEMENTS FOR THE OCEAN SCIENCES CAMPUS

Executive management approved the establishment of a multi-stakeholder **Ocean Sciences Technical Team** to provide operational oversight in respect of implementing the ocean sciences strategy. This team comprises representatives from relevant portfolios, including the Deanery and various support service divisions. The Technical Team oversees the preparation of integrated project proposals for approval by executive management to implement the ocean sciences strategy and monitors implementation progress.

Since 2015, strategic funding has been allocated annually to appoint a postgraduate research assistant and a project manager as part of the **Ocean Sciences Project Office** to assist the Senior Director: Institutional Strategy to develop and oversee the implementation of the University's ocean science strategy in collaboration with various internal stakeholders.

More recently, this funding has also provided for the appointment of **high-level consulting expertise** within the Strategic Resource Mobilisation and Advancement Office to provide strategic direction in respect of regional, national and international collaborative partnerships and resource mobilisation interventions to advance Mandela University's strategic aspirations to become a premier ocean sciences destination of choice.
Under the auspices of the Ocean Sciences Technical Team and the Ocean Sciences Project Office, benchmarking of selected institutional universities has been undertaken to inform

the principles and structural arrangements that will underpin the emerging ocean sciences governance and management model.

5. BENCHMARKING OF OCEAN SCIENCES GOVERNANCE AND MANAGEMENT MODELS AT SELECTED INTERNATIONAL UNIVERSITIES

In designing a fit-for-purpose, strategically aligned ocean sciences governance and management model at Nelson Mandela University, the principles underpinning renowned ocean sciences entities at various international universities were analysed to identify good practices that could potentially be customised within the South African context.

To this end, the scope of the benchmarking was limited to ocean sciences institutes at reputable universities with whom Mandela University has established partnerships and/or collaborative projects underway, including:

- Institute of Marine Research (IMR) (Norway)
- Oceans, Norwegian University of Science and Technology (NTNU)
- Southampton Marine and Maritime Institute, University of Southampton
- Marine Institute, University of Plymouth
- Oceans Institute, Western Australia
- Australian Maritime College, Australia
- National Research Foundation (NRF) iThemba Labs, South Africa

The lessons learnt from the benchmarking study will be outlined with a focus on the principles, structural arrangements and lessons learnt from the various models.

5.1 Institute of Marine Research, Norway

The Institute of Marine Research (IMR) in Norway is one of the largest marine research institutes in Europe, with nearly 1 000 employees. The main task of the Institute is to provide advice to national authorities, society and industry regarding questions related to aquaculture and the ecosystems of the Barents Sea, the Norwegian Sea, the North Sea, and the Norwegian coastal zone. For this reason, the national Ministry of Trade, Industry and Fisheries finances about fifty percent of the Institute's activities, while the balance of funding is generated through external research grants awarded to the Institute.

IMR's headquarters are in Bergen, but important activities are also carried out at the department in Tromsø, at the research stations in Matre, Austevoll and Flødevigen, and on-board a fleet of research vessels. The aim of the research and management advice provided by IMR is to promote the sustainable management of the natural resources in Norwegian marine ecosystems.

5.1.1 Management of the Institute

The management team of the Institute comprises of a Chief Executive Officer (CEO) with eight heads of portfolios reporting to the CEO. These portfolio leaders includes four heads

of research portfolios (namely, Research and Advice Programmes, Marine Ecosystems and Resources, Aquaculture, Environment and Technology, and Seafood, Nutrition and Environmental State) and four heads of operational portfolios (namely, Departments of Infrastructure, Research Vessels, Administration, and Communications and Public Relations).

5.1.2 Scope and core focus areas of the Institute

The research of the IMR is comprehensive and includes themes such as aquaculture, safe and healthy seafood, marine ecosystems, climate change, mining waste, bioacoustics, and plastic pollution in the oceans. IMR vessels, laboratories and research stations collect the data that inform its research and scientific advice.

The research and surveillance activities of the Institute are organised in projects and carried out in 22 thematic research groups. Scientists and technical staff have their organisational "home" in the research groups, many of which have employees working in the different geographical locations of the Institute. Project groups are established with members from the different research groups.

5.1.3 Lessons learnt

The lessons emerging from this model include the following:

- The *management model* of the Institute encompasses both heads of research and operational portfolios reporting into the CEO.
- Given the value of the research and scientific advice provided by the Institute, it derives half of its *funding* from national government and the balance from external research grants thereby enhancing its sustainability and reducing its dependence on University income.
- By strengthening *mutually beneficial collaborative networks* with various stakeholders such as government, industry and global funding agencies, the Ocean Sciences Campus could attract significant external funding by positioning itself favourably through offering valuable, research-informed scientific advice to inform policy and decision-making.

5.2 Norwegian University of Science and Technology (NTNU)

The vision of NTNU is to pursue *"Knowledge for a better world"* through interdisciplinary collaboration across faculties, centres and campuses in alignment with four overarching strategic research areas, namely Energy, Health, Oceans and Sustainability**.**

5.2.1 Scope and Core Focus Areas of NTNU Oceans

NTNU Oceans is one of NTNU's four strategic research areas and seeks to contribute to Norway's role as a maritime nation under the banner of ***knowledge for a sustainable ocean***. The following themes guide the research and innovation activities of NTNU Oceans:

- Into the deep ocean: Knowledge for a more efficient and precise monitoring and exploration of the ocean space.
- Marine environment, society, and sustainability: Knowledge for the analysis of ocean science and technology in a societal, environmental and sustainable perspective.
- Marine minerals and renewables: Knowledge for a better utilisation of marine minerals and renewable energy.
- Maritime transport: Knowledge for a safer, smarter, more environment-friendly and energy-efficient maritime transport.
- Polar science and technology: Knowledge for more secure marine installations, operations in Polar Regions.
- Sustainable seafood and marine bioresources: Knowledge for sustainable fisheries and aquaculture, in both land-based and exposed areas.

Academic programmes and qualifications

Academic programmes and qualifications offered by NTNU in the broad fields of marine and maritime science and technology are outlined in Annexure A and include the following:

- Bachelor studies;
- Master studies;
- Continuing education: courses and studies for employed professionals;
- MIT Entrepreneurship Accelerator Summer School; and
- Aquaculture related student and Masters' projects in the fields of biology, biotechnology, technology, and social sciences.

NTNU oceans internship programme

Students pursuing a practical course at any faculty/department at NTNU can apply for an internship at NTNU Oceans. Internships enable students to work in a truly interdisciplinary setting to apply their knowledge to work for a better world while acquiring invaluable experience.

Ocean Space Centre – a knowledge centre for future ocean space technology

Success in future technological developments demands knowledge, coordinated actions and modern tools. In autumn 2011, Norwegian Marine Technology Research Institute (MARINTEK) (https://marinetek.net/) completed and submitted a concept study for a future national research centre on ocean space technology to the Ministry of Trade and Industry. This Ocean Space Centre will form part of the national knowledge and innovation infrastructure and will position Norway as an international centre of gravity in ocean space technology.

The objectives of the centre are to:

- Educate future specialists in ocean space technology;
- Ensure that industry and government enjoy access to leading expertise and infrastructure associated with the harvesting and management of our oceans;
- Contribute to effective utilisation of national expertise and knowledge through collaboration with Norwegian and foreign institutions and companies; and
- Actively contribute to increased innovation in ocean space technology.

The development of the Ocean Space Centre and the new infrastructure, complemented by the growing collaboration between industry and research institutions at national and international level, will promote Norway's international positioning, future welfare, and competitiveness.

Ocean School of Innovation

Sustainable oceans need creative ideas, new research, innovations, and people that see possibilities. The objectives of the NTNU Ocean School of Innovation include the following:

- Develop competence and culture for innovation;
- Identify business opportunities for new and existing industries based on the outcomes of research conducted by NTNU Oceans; and
- Share research and innovation contributions to assist with the development of ocean industries.

Ocean Week

Ocean week is the annual conference hosted by NTNU Oceans as a vital part in contributing to Norway's role as an ocean nation. Previous Ocean Weeks have received visits and contributions from leading scientists, artists, industry and business representatives, diplomats, politicians, activists, and even royalty. Around 300 participants each day follow more than 200 presentations where national and international speakers present the latest developments on Ocean Sciences and discuss the impact that ocean research, technology, innovation, and policy making have. In addition to the daily sessions, stands, art exhibits, robotic demos and workshops provide a great networking arena for the companies and institutions represented.

Although there is no specific information on the NTNU website regarding the organisational arrangements pertaining to NTNU Oceans, there is a vast array of centres, infrastructure and facilities, as well as an impressive innovation and entrepreneurship ecosystem which can be accessed from the website: https://www.ntnu.edu/oceans

5.3 Marine and Maritime Institute, University of Southampton, United Kingdom

The Southampton Marine and Maritime Institute (SMMI) at the University of Southampton is an internationally recognised centre of excellence for marine and maritime innovation, education and expertise that addresses contemporary global marine and maritime challenges.

5.3.1 Scope and core focus areas of the Institute

SMMI has created a unique cross-disciplinary spectrum covering humanities, natural sciences, physical sciences and social sciences where knowledge acquisition and application is pursued in a collaborative manner with business, industrial and civic societies in a manner that enhances productivity, economic growth and sustainability. Knowledge generated

through the Institute's collaborative research is also applied in teaching to develop the next generation of marine and maritime professionals.
The scope of the Institute spans the following core focus areas, namely:

Safety, risk, and regulation

Improving safety is the key driver for maritime technology. In collaboration with Lloyd's Register global classification society, the Institute brings together engineering, legal, environmental, and humanities disciplines, to improve maritime safety.

Impact, culture, and heritage

Humans have an inextricable link to the oceans and preserving maritime culture and heritage is crucial for learning about how this relationship with the oceans has evolved. Minimising human impact on the ocean is vital for a sustainable future and new marine technologies, such as offshore renewables, need to take this into consideration.

Environment modelling and mapping

Mapping the ocean relies on new technologies to collect data, conduct complex ecosystem modelling, and policy and regulation development to share resources. Through this expertise, SMMI can help tap some of the vast economic opportunities in a responsible, sustainable manner.

Big data and cybersecurity

Access to ever increasing volumes of ocean data allows the Institute to develop more realistic models and projections of the marine environment and processes. Through secure data management systems, SMMI can also track ships and other objects to help improve the efficiency of trade and transport.

Vessel design and performance

Modern vessels need to be safe, efficient, and environmentally friendly. SMMI is at the forefront of these technological advances to design new flexible hull forms, advanced materials, alternative propulsion systems and fuel types.

Materials, structures, and testing

SMMI has a strong focus on advanced composites and is helping to secure their wider adoption in the marine and maritime sectors. Furthermore, advances in autonomous systems will open new opportunities for optimised control and could revolutionise ship design and operation.

Robotics and autonomous systems

Capitalising on autonomous and semi-autonomous vehicles needs underpinning research both in technology and regulation, ensuring safety, reliability, and efficiency. SMMI has capacity in air, surface, and underwater systems, as well as autonomy in existing control systems to improve efficiency. Design, control systems and application are all emerging areas of business.

Tourism, ports, and logistics

Over 90% of global trade is shipped by sea and ports are important gateways for trade and tourism. As demand increases, moving people and cargo around safely and efficiently becomes ever more complex. Advanced mathematics is being used to develop algorithms to enable port operators and supply chain managers to improve the efficiency of operations, thereby reducing cost and minimising impact.

Energy and resources

The potential for energy and resource extraction from the ocean is vast: from oil and gas extraction, to wind, wave and tidal energy generation, fishing and aquaculture and seabed mining. This is an exciting area of potential economic growth, but it needs careful management.

5.3.2 Organisational arrangements

SMMI is one of four Institutes and five University Strategic Research Groups (USRG's) established at the University of Southampton to bridge conventional boundaries between research disciplines to create innovative solutions to global dilemmas in partnership with industry, government, and society. The Institute comprises a community of 350 academics and 52 students from across the University whose research is linked to the focus areas of SMMI. Participation by academics and students is voluntary and in the main based on the nature of the research undertaken.

The head office of the Institute is located at the Boldrewood Innovation Campus and is linked to another five of the seven University campuses. The Institute is managed by a small core team with senior leadership and administrative staff constituted as follows: a Director; two Deputy Directors who are expert academics in marine and maritime fields; as well as an Interdisciplinary Research Coordinator with knowledge of the University and the sector. The Institute furthermore serves as host to five Research Fellows who are academics and lecturers in various marine and maritime disciplines at the University.

5.3.3 Lessons learnt

Various lessons can be derived from the University of Southampton SMMI model and several of these emerged during a video conference meeting with the Director of the Institute and one of the Deans. Most notably, it was emphasised that the ocean sciences governance and management model must create the conditions for:

- Co-ownership and transdisciplinary collaboration;
- Mutually beneficial, symbiotic relationships between the faculties and the campus;
- Avoid the tragedy of the commons – need for coherence and smoothing out of asymmetries through consistent rules of engagement across the campuses, entities and research chairs;
- Minimal bureaucratic or administrative structures and arrangements; and
- Inclusion of intellectual, industry, government, and civil society entities to promote quadruple helix partnerships.

Management and leadership

The SMMI model indicates that effective management is possible with a small operations team and minimal bureaucracy. This promotes agility and flexibility to enhance the responsiveness of the Institute to global trends, while also guarding against a complex structure with multiple "spaghetti" reporting lines. Furthermore, the governance and management model should be sufficiently agile and flexible so that it can evolve and 'morph' over time.

The experience of SMMI also depicts the value of inter- and transdisciplinary collaboration and this should foster outcomes that are greater than the sum of the parts. The management team of the Institute should reflect and enable interdisciplinary cooperation and the Institute must remain integrated with the rest of the University so that it is not jealously guarded as an "empire" with the University community having no knowledge of its work or impact.

Trust in the institute's leadership is crucial and and the senior intellectual lead should enjoy academic credibility while being gregarious in chasing strategic opportunities with visionary altruism. The key performance indicators of the campus leadership should include value add as measured through funding generated, industry engagements and partnerships, research proposals developed, and cross-disciplinary collaborative teams established.

The campus head must forge links or partnerships nationally and internationally, including scanning the horizon for strategic, intellectual, and funding opportunities. Furthermore, it was strongly recommended that the institute/campus leadership role should not be for life, but rather a three to five-year term of office to generate new ways of thinking, fresh insights and innovation.

Network of scholars and partners

The experience of SMMI strongly suggests that it is essential to demonstrate to faculties and academics that being located on and/or collaborating with academics on the Ocean Sciences Campus will benefit them and their students. The Director of SMMI recommended that the Campus should not operate as a silo but should create opportunities for fostering a transdisciplinary network of scholars and partners to promote ownership by the wider University community. Furthermore, the workload of all academics and scientists working in the Institute includes undergraduate teaching in their home faculties to ensure that the richness of the scholarship being conducted by the Institute enriches the undergraduate curriculum.

The Campus should be an attractive space to enable engagement between students, academics and external stakeholders from industry, government, and civil society. The advantages of being located on a university campus must be clear and this could be achieved through establishing an innovation hub where external agencies benefit from the

facilities, equipment and scholarship of the University (e.g. 3D printing, digital modeling, simulation, etc.). Being located on the campus could also serve as a catalyst for spin off activities for the purposes of business incubation and entrepreneurship.

Revenue and cost sharing

Engaging with the colleagues from the University of Southampton further revealed that "tension grows where the money flows". At Southampton, funding flows to the faculties and not institutes/campuses to guard against unhealthy internal competition over resources.

It was indicated that SMMI adds strategic value to the University without competing with faculties for resources. It does so through support for research proposal writing and revenue mobilisation, industry engagement and cross-disciplinary collaboration. Top sliced funding is allocated to SSMI which partly pays for salaries and postdoc and postgraduate students. The salaries of the core management team are sourced from their home faculties while, in turn, funding from their research activities and outputs flows back to these faculties. In a mature system, like SMMI, these funding arrangements allow for a measure of continuity and stability for the Institute, while simultaneously incentivising researchers to generate own funding through research grants and collaborative partnerships nationally and internationally. It was emphasised that increasing the status and impact in a niche area like ocean sciences should benefit the whole university and, to achieve this, it is necessary to invest primary seed funding to promote collaboration among faculties.

Furthermore, talented scholars and postgraduate students follow funding and research opportunities and Mandela University needs to leverage off its locational advantage and proximity to the Indian Ocean. In doing so, the University can tap into research funding and collaborative international partnerships, especially through the Global Challenges Fund within the context of the Decade of the Ocean. NMU offers unique access to the Western Indian Ocean and this is strategic advantage which should be used to attract international fellows and researchers.

5.4Marine Institute, University of Plymouth, United Kingdom

Plymouth University has three institutional entities and the directors meet with DVC Research three times a year to share lessons. The Marine Institute at the University of Plymouth represents approximately 3000 staff, researchers and students across four faculties in the university (i.e. science and engineering, arts and humanities, business, health and human sciences). The Institute provides a single portal to the University's extensive pool of world-leading experts and state-of-the-art facilities, enabling the University to understand the relationship between the way we live, the seas that surround us, and the development of sustainable policy solutions.

The Institute has a wide-ranging focus from marine biology to shipping, humanities, engineering, offshore renewable energy, medicine through to deep sea exploration. This is complemented by marine organisations in the city of Plymouth which collaborate with the University**.**

5.4.1 Scope and core focus areas of the Institute

The Marine Institute integrates multidisciplinary expertise in marine and maritime research, education, technological innovation, and business leadership to train new scientists, engineers, policymakers, artists, technicians and business managers of the future. Marine research at the University of Plymouth can be summarised into eight broad themes, which are outlined below with key research areas listed.

Coastal and ocean science

The Centre for Coastal and Ocean Science and Engineering brings together a coherent group of internationally recognised research staff from across the marine physical sciences, coastal geography, and coastal engineering to further Plymouth's international research reputation in these areas. The mission of the Centre is to understand and predict the functioning of coastal and ocean systems in support of appropriate management of resources and activities. The Centre comprises three research groups, namely: Coastal Processes; Marine Physics; and COAST Engineering Research.

Engineering for the marine environment

The University's engineering expertise covers a broad array of research on manufactured structures and devices that are deployed in marine and coastal settings. The University is a leader in marine renewable energy research. The COAST Engineering Research Group has strengths in physical and numerical modelling of marine renewable energy devices, supported by state-of-the-art COAST Lab facilities. The University is also a key partner in the Partnership for Research in Marine Renewable Energy (PRIMaRE).

The Autonomous Marine Systems (AMS) research group comprises a multidisciplinary team working on the application of AI techniques to the navigation, guidance and control of autonomous vehicles, wave energy devices and marine propulsion systems. The Advanced Composites Manufacturing Centre (ACMC) is a leading composites R&D facility with a strength in composites for the marine environment, although their work has a wide range of applications. The research carried out in the Materials and Structures Research Group covers many aspects of mechanics in materials and structures. The Engineering and Society Research Group focuses on the interaction between engineering solutions, society, and the environment.

Marine biology, ecology, and conservation

Plymouth has a long tradition of marine biological research that has seen it develop into a world-renowned centre of excellence in this area. This encompasses research on all aspects of marine life from molecular and cellular biology to whole organisms, ecology, and their conservation. The Marine Biology and Ecology Research Centre addresses a broad range

of research questions, from the effects of environmental stress on microbes and developing embryos to the management of large-scale impacts, such as global climate change.

The Marine Conservation Research Group investigates the consequences of human activity on marine biodiversity and its ecosystem services to provide scientific evidence and management advice for the benefit of marine ecosystems and society. The International Marine Litter Research Unit has a mission to promote further understanding of the impacts of marine litter on the environment and society, to identify the solutions and the pathways necessary to achieve them. The Ecology and Evolution Research Group focuses on marine and coastal biology as it relates to seawater flooding of coastal environments, Intertidal ecological patterns, Eco-engineering of coastal defenses and climate change effects on species distributions.

Biogeochemistry

The Biogeochemistry Research Centre comprises expert researchers and instrumentation, with acknowledged international leaders in organic geochemistry and environmental analytical chemistry, a strong focus on marine science, and current and past ecosystems and climates.

Marine geosciences

The Centre for Research in Earth Sciences undertakes marine geoscience research and engages with key aspects of how oceans interact with the wider earth system. This includes how the earth's climate has changed in the past and how ocean chemistry and ecosystems have responded to this change. This can help predict how the oceans might react to future predicted climate change and ocean acidification.

Coastal geography and marine policy

The Marine Conservation Research Group investigates the consequences of human activity on marine biodiversity and its ecosystem services to provide scientific evidence and management advice for the benefit of marine ecosystems and society. A major focus of recent work has been the improved understanding of rapid environmental transitions during periods when the Earth System has readjusted to abrupt climatic shifts, giving a long-term perspective on projected 21st-century warming and sea-level rise.

Shipping and maritime business

Whilst the ship is still a critical part of the supply chain, other activities such as international logistics, port activity and intermodal operations all play a key role in maritime commerce. The International Shipping and Logistics Research Group focuses on governance of the maritime logistics and supply chain management sectors, with a particular emphasis on developing and transitional economies and how they interact in the context of globalisation, sustainability, and cyber security threats for ship-based operations.

In addition, the Marine and Maritime Law Research Group have research interests in numerous aspects of environmental regulation and marine and maritime law including environmental Impact assessment, protection of cultural heritage, and marine and

terrestrial conservation. The Plymouth Marine Navigation Centre delivers training and development to a new generation of professional seafarers through modern, state-of-the-art facilities, including the CAD Modelling facility where new visual scenes are developed for use in the ship simulator.

Marine culture

It is widely recognised that the marine realm has had a profound impact on the development of human society and continues to stimulate creativity across the full spectrum of human expression. Marine Cultures is a key theme of the Arts Institute and the Land/Water and the Visual Arts Research Group consists of artists, writers and curators who embrace a diversity of creative and critical practices to interrogate nature and culture, aesthetics, and representation. The Maritime History Research Group focuses on global and regional maritime and naval history, including the voyages of discovery.

5.4.2 Organisational arrangements

The management of the Marine Institute consists of a small core operations team comprising a Director in a 50% role, a Deputy Director who is also in a 50% role but currently vacant, and a Senior Administrator. The Strategy Board of the Institute is constituted by two academic representatives per research theme, all of whom are housed in various faculties. These academic representatives are expected to take the messages about the Institute and its work back to their faculties to promote close collaboration and synergies between the Institute and the faculties. However, these responsibilities are not built into the workload or key performance indicators of these academic representatives, which makes it difficult for the Director of the Institute to have high expectations in respect of their contribution. The Board also consists of a Director of Industrial and Strategic Partnerships who coordinates high value partnerships with private and public sector organisations and ensures that the Institute's research output is socio-economically impactful.

5.4.3 Lessons learnt

Management of the Institute and interface with faculties

The Marine Institute is one of three institutional entities at Plymouth University and the directors meet with the DVC Research three times per annum to share lessons, opportunities, and challenges. The Director of the Marine Institute was likened to an orchestra conductor who facilitates and shepherds multi-disciplinary collaboration across faculties, exercises diplomacy in steering internal niches to address external priorities, and acts as the face of the University in projecting the marine sciences strengths to external stakeholders to mobilise funding and partnerships. The Director meets regularly with the heads of faculties and schools to build relationships and proactively address faculty-specific challenges that impact on the Institute before they escalate. In this context, it is essential to decide what is feasible in terms of the role of the Ocean Sciences Campus and clearly communicate what it can and cannot do. Furthermore, it is important that the Director is a

respected intellectual leader with gravitas and the ability to engage with high-level internal and external stakeholders in driving the ocean sciences strategy and managing the campus.

The Plymouth model indicates that effective management of the Institute is possible with a small operations team led by a reputable intellectual who assumes the role of Director as a "second hat" responsibility. The Director does not have any direct authority over academics who contribute to the work of the Institute and it is therefore important to forge virtuous mutual reciprocity between the Institute and the faculties. In doing so, the Institute focuses on building relationships and horizontal connections internally to promote good will.

The Marine Institute needs to be run as a democracy to promote broad-based ownership and participation across the university system. To this end, it is essential to strategically manage the interface between the Director of the Institute and the heads of schools and faculties. It is important to identify the benefits that academics and faculties derive from participating in the work of the Institute. The Institute leverages seed funding for collaborative projects that showcase the University, the Institute, and the faculties where the contributing researchers reside.

The Plymouth experience shows that it is important to establish an open science platform where there is mutual reciprocity between the faculties and the Institute with continuous feedback loops into the faculties. Another key takeaway is the employment of a Director of Industrial and Strategic Partnerships to foster partnerships with key external stakeholders in pursuit of quadruple helix collaboration and partnerships that advance science for society. To this end, the Ocean Sciences Campus leadership team should have the capacity to intentionally build relationships and forge partnerships with key organisations in the city, provincially, nationally, continentally, and beyond.

Thematic focus areas

The eight ocean sciences research themes at Plymouth are intended to promote inclusion internally by involving all faculties, but not all of these have equal gravitas due to varying levels of output, productivity, and funding. Most of the activity and research output of the Institute is currently generated by Science and Engineering at Plymouth.
In the context of the Nelson Mandela University, it would be important to ensure that the thematic focus areas for oceans and coastal sciences promote broad-based participation by all faculties internally, while also aligning with externally facing priorities – in other words, consider what the grand challenges and opportunities are globally and how to organise research themes and sub-themes accordingly. This is important for establishing partnerships and leveraging resources from government and private funders to support the mandate of the OSC.

Space utilisation

The Marine Institute at Plymouth has limited physical space and finds itself challenged in terms of conducting certain activities that would promote the building of relations and

profiling its work. The Director pointed out that the Ocean Sciences Campus at Mandela University has the benefit of dedicated space to pursue opportunities such as:

- Bringing people together to work collaboratively on developing and implementing research grant proposals across disciplines and faculties;
- Hosting visiting academics, postdoctoral fellows, and postgraduate students to share ideas and collaborate on collaborative, transdisciplinary projects; and
- Hosting events and public lecture series to showcase the ocean sciences strengths, niche areas and expertise of the University.

It was recommended that the University manage facilities and infrastructural resources on the Campus centrally to ensure that these are shared across all faculties and entities to promote transdisciplinary collaboration.

Revenue and cost sharing

The Marine Institute has no direct authority, only influence, over academics and a limited budget. Salaries are funded by home faculties. All assets of the Marine Institute are funded and managed by the heads of schools and faculties. The advice to Mandela University was to make a case for funding to be partly top sliced at institutional level to resource the ocean sciences strategy with the balance to be contributed by the participating faculties, research chairs and entities.

It is important to note that tensions increase in a resource constrained context and it is therefore necessary to identify the incentives, benefits and "sweeteners" that academics and faculties derive from participating in the work of the Marine Institute. The Marine Institute adds value to Plymouth University by leveraging seed funding to connect people across disciplines to design collaborative research-informed solutions that showcase the individual researchers, the Institute, and the University. In this way, the benefits of collaborating with the Institute are clear to researchers and postgraduate students from various faculties.

5.5 Oceans Institute, University of Western Australia, Australia

The vision of the Oceans Institute at the University of Western Australia is to be the leading global oceans research and training centre focused on the Indian Ocean. To this end, UWA has identified oceans and the marine environment as one of its seven 'Grand Challenges' in its 2030 Vision and Strategy. UWA recognises the potential for ocean research to deliver significant socio-economic benefits locally and globally. Through the Oceans Institute, the University is responding to the national imperative, as articulated by the Australian Research Council, that university research should not only be internationally acknowledged through peer review but should also have a tangible positive impact.

5.5.1 Scope and focus areas of the Oceans Institute

The Institute pursues large projects that utilise the full breadth of interdisciplinary skills, working in collaboration with industry, government, and community partners to provide solutions to the many challenges facing the world's oceans. Desalination, wave energy, algae biofuel research, ocean nourishment and aquaculture are just some of the ocean-based solutions in which the Institute is involved to safely and sustainably provide critical resources for human development, water, food, energy and bio-resources. The integrated human-marine perspectives can provide valuable insights into how seascapes might be managed into the future.

The UWA Oceans Institute is a flagship research entity for the University, created to enhance impact-oriented research. Some of these areas are more advanced than others, in terms of cross-disciplinary maturity and engagement with external partners. Inevitably, at the end of the four-year period some will be more successful than others, while other unanticipated opportunities will have arisen. In the journey through the strategy period, the UWA Oceans Institute will, on behalf of the University, broaden its collaborative reach and expand its partnerships. The Institute's cross-disciplinary research is grouped under five integrated themes, namely:

- Energy from the oceans;
- Maritime security, safety and defense;
- Fisheries, food security and aquaculture;
- Marine conservation, ecology, and climate change; and
- Coasts and communities.

The 2018-2021 research strategy of the Oceans Institute sets out its mission to provide innovative and effective solutions to national and global challenges facing the world's oceans through:

- Developing cross-disciplinary graduate courses in marine studies;
- Continuing to grow strategic local, national, regional and international collaborations;
- Establishing partnerships with government agencies, non-governmental organisations, industry and communities;
- Significantly enhancing its reputation nationally and internationally for the quality and impact of its research; and
- Ensuring this research is adopted and applied for the benefit of Australia and the global community.

5.5.2 Organisational arrangements

The Oceans Institute unites experts across a wide range of disciplines, from core focus areas in marine biology and ecology, physical oceanography, and ocean engineering, through to the health and social sciences, including legal perspectives. In each of these disciplines, new knowledge could advance social and economic development and wellbeing. Brought together, these multidisciplinary capabilities have the capacity to deliver significant societal

benefits. The Institute furthermore has one or two experts who lead each of the research focus areas of the Oceans Institute to promote the sustainable use of ocean resources.

The management and governance of the Oceans Institute consists of a small team which runs the day-to-day operations and an External Advisory Board.

- The **core management team** of the Oceans Institute comprises a Director, Business Support Manager, and an Executive Assistant all of whom have expertise, skills and interests in ocean sciences and collaborative work.
- The **external advisory board** is made up of a Chair and five other members who are senior representatives from major research institutions, industry, and government. The Board provides independent, high-level advice on industry and policy needs, as well as trends in the Indian Ocean region, to guide the Institute's strategic planning and research agenda.

5.5.3 Lessons learnt

The following lessons can be drawn from the Oceans Institute model, namely:

- The cross-disciplinary composition of the strategy team suggests that it serves an advisory role that supports the core operations team in leading the research and socio-economic impact agenda of the Institute. This also promotes ownership of the Institute by the faculties contributing to its work.
- Both the Deputy Director and Business Support Manager have business development expertise for the purposes of enhancing the Institute's marine research collaboration capabilities. This could serve as a good example for Mandela University, to assist in fostering industry and Science Council partnerships in line with the goals of the quadruple helix partnership model.

5.6 Australian Maritime College, Australia

The Australian Maritime College (AMC) at the University of Tasmania is a national institute recognised as a centre for excellence for maritime education, training and research. It has an internationally acclaimed suite of specialist teaching, learning and research facilities used by industry and government organisations worldwide to address leading-edge research questions.

AMC is in the island state of Tasmania with a second campus in Beauty Point that is home to a fleet of training and research vessels. AMC is a strategic partner of the Naval Shipbuilding College, to promote collaboration between industry, government, and academia to deliver the expertise and workforce required for Australia's naval shipbuilding programme.

5.6.1 Education and training

AMC offers a wide range of courses from vocational training through to bachelor, postgraduate degrees, and doctorates, spanning the following areas:

- Maritime engineering and hydrodynamics;
- Maritime business and international logistics;
- Ocean seafaring; and
- Coastal seafaring and VET courses (refer to Annexure D for more detail).

AMC students are provided with flexible course options, with opportunities for full-time, part-time, and online distance study to equip them for careers in naval shipbuilding, maritime engineering, maritime logistics and shipping, and real-world research opportunities.

5.6.2 Research

AMC conducts research in diverse areas such as maritime renewable energy, naval architecture, fluid dynamics, offshore engineering, human-centred design, sustainable ports, and underwater robotics. Five cross-disciplinary research themes traverse traditional scientific and engineering boundaries to address challenges across the entire maritime domain including the following:

- Maritime Defense;
- Blue Economy;
- Maritime Engineering;
- Innovations in Maritime Education, Operations and Training; and
- Innovative and Sustainable Ports, Shipping and Supply Chains.

5.6.3 Governance

AMC is the primary national institute for Australia focusing on training, education, and research for the maritime sector. AMC is an institute of the University and operates in a manner that is consistent with the pursuit of the mission and strategic plan of the University. AMC has an Advisory Board that is appointed by and accountable to the Vice-Chancellor and a Chief Executive appointed by the University.

5.7 NRF iThemba Labs

The iThemba Laboratory for Accelerator Based Sciences (iThemba Labs) in the Western Cape, South Africa is a multidisciplinary research facility that is based on the development, operation and use of particle accelerators and related research equipment. It is a publicly funded national facility owned and operated by the National Research Foundation (NRF) and provides a pool of talent, skills, and capabilities that no single university could maintain on its own.

5.7.1 Scope and focus areas

iThemba Labs is the African continent's largest facility for particle and nuclear research for commercial, research and medical applications. In addition, its facilities include a full

radiotherapy clinic for the treatment of certain cancers using both proton and neutron therapy.

Over the years, iThemba Labs and nuclear physics departments at South African universities have carried out fundamental and applied research which is closely linked to applications with significant value to society and the economy ranging from energy generation to medicine. Student training is an integral part of this environment and provides young South Africans with the tools necessary to enter the workforce as highly skilled professionals, providing the basis for the future success of the South African knowledge-based economy.

iThemba Labs have various collaboration agreements and joint training programmes with higher education institutions and research laboratories around the world to contribute to the human capital development mandate of the NRF. The laboratory also provides a platform for South African researchers and postgraduate students to access global research facilities in other parts of the world. To maintain and increase the excellence of the research and training activities, iThemba LABS has developed a globally competitive research strategy and a related research infrastructure acquisition plan.

5.7.2 Governance and management

iThemba Labs has a combination of resident scientists and visiting academics from other universities who work on distinct collaborative projects. The core operations team of iThemba Labs comprises a Director, Deputy Director (Research Coordination), as well as units for Human Resources, Finance and Business Administration and an International Relations Desk.

An Advisory Council and its Chairperson are appointed by the President of the National Research Foundation, in consultation with the Executive Director/Vice President: National Facilities and the Director of iThemba LABS. The functions of the Director's Council include advising the Director on:

- Policies and strategic directions for research, training, service and outreach programmes;
- Transformation programmes, both scientific and organisational;
- Strategy and issues relating to the iThemba Labs operations; and
- Strategy and issues relating to iThemba Labs' internal and external stakeholder relationships, its interaction with higher education institutions and the wider science community.

The Advisory Council is constituted of the following members:

- Three senior academics (physicists) from the University community.
- Three senior academics / professionals from the medical physics/nuclear medicine community.
- The Chair of the iThemba LABS Physics Users Committee (ex officio);
- The Chair of the Particle Therapy Users Committee (ex officio); and
- The Director of iThemba LABS (ex officio).

5.7.3 Lessons learnt

The iThemba Labs model demonstrates that expensive, world-class research facilities and infrastructure can benefit researchers and postgraduate students nationally and internationally through collaborative partnerships and governance arrangements. In a similar vein, national government has invested extensively in the Ocean Sciences Campus, as well as the South African International Maritime Institute (SAIMI) at Mandela University and this needs to be optimally leveraged to ensure that the University becomes a destination of choice for ocean sciences on the African continent. This should lead us to position the Campus further within the national science and innovation system with the goal of attracting and securing investiture of major new national ocean science and technology facilities and a large-scale research and innovation programme funded by the national science system.

Furthermore, the governance and management model that is designed for Ocean Sciences should enable and facilitate collaborative networks that seek to harness the expertise of leading scientists, as well as industry, government and civil society stakeholders to offer guidance to University leadership in steering the strategic direction of the Campus. To this end, the design of the governance and management arrangements should aim to simultaneously enhance ownership and buy-in of the Ocean Sciences Campus among internal stakeholders, while also optimising the strategic collaboration and inputs of respected external stakeholders and partners.

6. OCEAN SCIENCES ENGAGEMENTS WITH DEPUTY VICE-CHANCELLORS AND EXECUTIVE DEANS

The Ocean Sciences Project Office at Mandela University engaged with all Deputy Vice-Chancellors and Executive Deans in April and May 2020 to obtain their inputs in respect of the governance and management model for the Ocean Sciences Campus, including the interface between the campus, the faculties, relevant research and engagement entities, as well as the research chairs. The thematic outputs of these engagements are outlined below.

Ocean sciences governance and management model	**Humanities:** • Establish lines of communication with research chairs as it relates to faculties, including clarifying roles and expectations. • Every research chair and entity must be linked to one or more home faculty even if they are located on a different campus. • Need for broad – based participation by faculty members in planning as opposed to only engaging the DOS/HODs as has been done in the past.
	Law: • There is a need for a consistent approach in managing research chairs.

	• Ensure ongoing engagement with the research chairs and entities by the Executive Dean through maintaining a hands-on approach. • Be explicit about research chairs who are established at institutional as opposed to faculty level to foster a day-to-day reporting line to the relevant institutional entity and/or line manager (e.g. CMR reports to DVC RII). • Navigate "grey areas" in respect of the dotted reporting line of research chairs to the Executive Deans versus the solid reporting line to the DVC RII. • Where the relationship between the faculty and research chair/entity is strained, the issues can be addressed by DVC RII in collaboration with the Executive Dean, research chair and entity leader. • If academic programmes are to be developed and offered, it is important that this is done through the home faculty and academic departments. • Adopt an associational model to manage relationships across the system in manner that is linked to the ocean sciences research themes – as opposed to a conventional bureaucratic model. • Entity review: lessons learned from how research chairs and entities interface with the faculty. Principles are needed for managing research chairs/entities. • Do not be driven by finance when managing relationships. • NRF Chairs – it is a contractual requirement that they contribute at least 5% of their time to the faculty and this must be overseen and managed by the relevant Executive Dean in consultation with the research chair and the DVC RII. • Discussion with research chairs and entity leaders as to the best use of their time – i.e. in a manner that is mutually beneficial for the faculty, research chair and entity. • Channel the contributions of research chairs and entities to leverage their strengths and expertise, e.g. postgraduate supervision, while also protecting the research chairs so that they can attend to producing deliverables (e.g. limit meeting attendance and decrease administrative load). • All chairs must be linked to faculties but their contractual relationship with the faculty and the institution, as well as their deliverables and the support offered to enable them to produce required outputs, must be explicit. • Need to identify champions who drive strategy at faculty, entity and institutional level to keep momentum going.

	• Risk mitigation strategy to manage succession planning for research chairs and entity leaders who are currently leading stellar initiatives. • Leverage expertise of HEAVAS, adjunct professors and research associates. • Need to be intentional about building a network of capabilities and expertise around our research chairs to ensure continuity and momentum beyond the contribution of individuals. • Look at each of the research chairs and examine the extent to which they are building critical mass around them to promote continuity of expertise and succession planning. • Need for an Ocean Sciences Campus champion to drive and coordinate strategy with Deans.
	Science: • There is a need to distinguish between the Ocean Sciences Strategy and the Ocean Sciences Campus – the former is institutional and all faculties contribute, whereas the latter is in a distinct form unlike the other campuses and requires a management model that allows it to catalyse postgraduate research and innovation in Ocean Sciences with strong feedback loops into faculties. • The governance and management model needs to interface optimally with the faculties - the campus should support faculties and vice versa. • Entities and research chairs should also support the faculties in contributing to the University. • Within the model, academics should be able to pursue postgraduate supervision and research, while also contributing to undergraduate teaching and curriculum development. • There is a need to review the entities policy to align it with the outcomes of the entity landscape review. • Look at eNtsa and Innoventon as examples of symbiotic relationships between entities and the home faculties. • Postgraduate studies, research and engagement of entities must feed into teaching undergraduate programmes in faculties, including developing cutting-edge, topical modules and curricula. • A similar principle should apply to research chairs – impact should be part of their performance management. • Eliminate duplication by drawing on the expertise of entity leaders, research chairs and postdocs to contribute to the work of faculties. • Look at international labs as examples of a possible model for the Ocean Sciences Campus. For example, the NRF Ithemba

	Labs in Cape Town hosts a combination of resident scientists and visiting academics from other universities who work on distinct collaborative projects.
	EBET: • As part of the ocean sciences governance model, the University needs to explore how to harness the inputs of industry players to optimise our future-focused academic planning and investment strategies and enhance our responsiveness - similar to what we have in place for the automotive sector. • Challenge: Oceans economy sectors and industries are diverse and fragmented. • Need to establish a multi-faculty team to look into an organised platform to engage with various sectors of the oceans economy to assess opportunities to partner with them to solicit long term investments in novel academic programmes, bursaries, research and innovation projects, and collaborative partnerships.
	DVC P&Ops: • Extent of duplication of support services across campuses to be informed by academic requirements. • Assess whether centralised offering or matrix model is possible in respect of support service delivery. • Mandates or levels of authority in respect of campus management to expedite delivery. • Shared services model with common and unique requirements. • Cross functional campus management team to report into senior management as a single reference point. • Focus on improved efficiencies and cost saving. • Consider specialist vs generalist skills of campus management. • Assess the extent to which the campus is immersed in and part of surrounding community/neighbourhood, including safety and security. • Explore how to embed the Ocean Sciences Campus into the broader city, province, and nation through an ocean's economy "neighbourhood". • A *de novo*, smart campus management model can be implemented on the Ocean Sciences Campus while still being sufficiently integrated into the institutional systems – this requires systems–level thinking and conceptualisation. • The multi-campus governance and management model being developed as part of the organisational redesign process needs to make provision for the possible distinctive requirements of the Ocean Sciences Campus - DVC P&Ops to invite Dr Franks

	and Prof Nel to the org redesign workshop to promote alignment and integration.

	DVC L&T:
	• Interface between faculties, entities, and research chairs:
	  o Need to pull together academics working in the same domains and this should not be constrained by the existing structures and disciplinary/faculty boundaries.
	  o Academics can simultaneously be members of a faculty and/or interdisciplinary, cross-faculty teams – need to signal that dual affiliation is possible and supported by the Deanery.
	  o Staff workload needs to be relooked to enable dual affiliation and a fair distribution of work.

	DVC RII: • How to foster mutually beneficial relationships between entities and faculties – Executive Deans and faculties should see Ocean Sciences Campus and entities as enablers to enlarge their partnership footprint and increase research outputs. • Need to finesse the overarching principles at a practical, implementation level. • Entity review – conducted by internal role-players so may be inward looking; explore the possibility of convening a small panel of external peers from other universities to give an objective view. • Suitable metrics to assess the performance of entities consistently and fairly in terms of a range of outputs produced.
Resourcing model	**BES:** • Role of entities and staff workload; possibility of setting up a unit to focus on ocean economy with external funding; currently a Unit for Economic Development and Tourism is the driver of initiatives. There is a need for a dedicated capacity to drive this, but funding is needed. Postgraduate student involvement was not entirely successful due to the specificity of research topics; holistic interdisciplinary approach is needed.
	EBET: • Staff capacity in Marine Engineering – use our own students to possibly lecture. • Assembly and commissioning of equipment donated by Wartsila - Lead time to operate in multi-stakeholder and partner-driven context to optimally use such donations (e.g. for use in training for industry through SLPs). • Need a mechanism to be strategically selective in how we respond to opportunities that emerge, especially those that respond best to our infrastructure and facilities requirements and our capacity to promote sustainability. This will be critical

	considering anticipated cuts to higher education funding by government post-COVID. • Flag the need for senior staff capacity at PhD and professorial level in marine engineering and/or naval architecture going forward - explore how international partners could contribute expertise through exchanges and guest lectures etc.
	Education: • Staff capacity to teach content or expertise in maritime studies. • Need for an internal faculty champion to drive the maritime education thrust.
	Law: • The faculty benefits from a well-developed, mutually beneficial relationship with the research chair. • Establish the chair's linkage to the home department and faculty upfront. • Specify what the chair takes up with the DVC versus the Dean so that all involved can benefit from role clarity. • Need to explore how to build critical mass in research hubs aligned with the ocean sciences research themes to mobilise funding and enhance strategic positioning in a few, carefully selected niche areas (e.g. One Ocean Hub, WIO). • Think through the balance between the depth and breadth in our initiatives: o How to generate depth by being selective in taking up strategic opportunities? o Investments and resource mobilisation to be guided by this framework. o External review panel to objectively critique our thinking once we have developed a framework.
	DVC L&T: • DVC discretionary funding: a top slice for strategic projects like ocean sciences could be considered to facilitate and incentivise interdisciplinary, cross-faculty collaboration from a resourcing point of view. • Explore possibility of dual appointments where academics can contribute towards their home department and faculty while also being affiliated with the Ocean Sciences Campus for the purposes of research.
	DVC RII: • Staff profile: senior academics with PhDs retiring with a growing cohort of emerging academics who are often pursuing M&D qualifications.

	• Ever-increasing undergraduate student enrolments result in high teaching loads and this limits the capacity of academics to produce research outputs and supervise postgraduate students. • Different capabilities within the University ecosystem need to be mapped to assess the baseline across all faculties in respect of their potential contribution to ocean sciences. • Assess sustainability internally in respect of: o Staff capacity and workload; o R&I infrastructure including entities; and o Incentive/rewards and recognition systems.
Partnerships and linkages	**BES:** • Maritime high schools – focus on maritime economy as one of the subjects and the need for content expertise as part of teacher training and TVET lecturer development. • Hub of convergence for ocean sciences: a physical platform for academics, students, industry role players and government to come together. • We can learn from NTNU and Southampton where industry role players and partners rent space on university campuses to foster quadruple helix partnerships and collaboration.
	EBET: • Marine robotics - communication capabilities of underwater vessels (land based and satellite) to be explored further. • Energy and food security are going to be critical factors in stimulating the national economy post-COVID (including logistics and technology in the value chain and healthcare). • Biomedical supplies and equipment as a part of our contribution to national reindustrialisation, including current support to government in respect of medical technology and ventilators. • Transportation and smart technologies. • Drs Swartz and Franks to schedule follow up engagement with Prof Van Wyk to discuss EBET response and contributions to national and provincial economic growth strategies along with potential funding opportunities.
	Education: • ECDOE review of CAPS curriculum documents of maritime high schools (i.e. maritime studies and nautical science). • Maritime consciousness or awareness among school learners from primary school level upwards – using R20m funding from Department of Environment, Forestry and Fisheries for such awareness programmes.

	• Leverage existing partnerships with rural villages (e.g. Willowvale) to promote maritime consciousness and oceans economy. • Leverage partnership with EC province (e.g. Port St Johns) to empower schools and coastal communities.

	DVC RII:
	• Potential for UNESCO chair in ocean sciences – they bring prestige and networks at an international level.
	• Consider pursuing the proposal to establish a transdisciplinary Sustainability and Systems Science Institute at the University of which ocean sciences could be the hub.
	• Example of an opportunity for transdisciplinary work: https://www.belmontforum.org/cras/#pathways2020
	• Formalise links with leading international ocean sciences universities and institutes, such as:
	  ○ TUMSAT
	  ○ Norway
	  ○ Southampton
	  ○ Plymouth
	  ○ Erasmus plus and Erasmus Mundus projects

Marketing and branding	• More concerted marketing effort is needed to improve enrolments and enhance viability of under- and postgraduate ocean sciences qualifications. • Marketing and branding to raise awareness of how we are responding to the technologically driven needs of the oceans economy. • Develop compelling marketing materials outlining career opportunities and trajectories in ocean sciences. • National campaign required to encourage school learners to pursue careers in ocean sciences. • We need to differentiate between marketing the Ocean Sciences Campus and the associated niche areas of the University more broadly as opposed to the specific programme offerings and qualifications at under- and postgraduate level. We need to position Mandela University more assertively as a destination of choice for ocean sciences in South Africa and on the African continent.

The next section will outline the key dimensions of a governance and management model that facilitates and enables transdisciplinary collaboration where the abovementioned principles and requirements are met.

7. RECOMMENDATIONS TO FACILITATE AN INTER- AND TRANSDISCIPLINARY OCEAN SCIENCES GOVERNANCE AND MANAGEMENT MODEL

Adaptive governance and management are key to connecting inter- and transdisciplinary efforts across multiple organisational levels. The challenge is to harness the inter- and transdisciplinary energies of a system that has primarily been shaped over centuries by the progressive specialisation of knowledge within academic disciplines while not compromising the benefits of disciplinary depth and expertise.

From this report, several key principles have emerged as it relates to designing the University's ocean sciences governance and management model. These include the need to implement the following recommendations and proposals, namely:

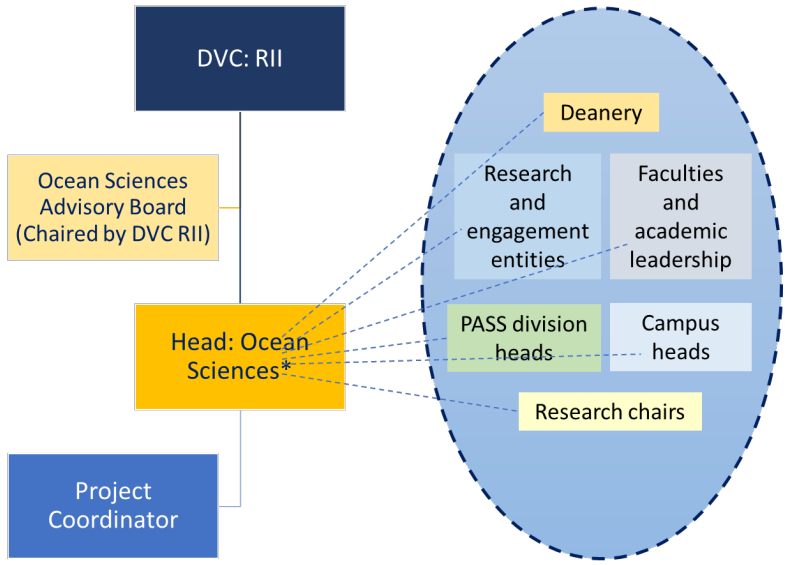
- The Ocean Sciences Strategy should focus on building critical mass in research and innovation hubs aligned with carefully selected, externally facing **transdisciplinary thematic areas** that strengthen the strategic positioning of Mandela University as a premier destination of choice for ocean sciences. These **research and innovation hubs** should serve as catalysts for pursuing transdisciplinary scholarship and engagement that respond to complex, multi-dimensional sustainability challenges confronting our oceans, society and the planet.
- All faculties should be encouraged to review their Programme and Qualification Mix (PQM) to assess opportunities to develop and offer distinctive, *de novo* inter- and transdisciplinary academic qualifications, modules and short learning programmes through flexible modes of delivery that address the skills and innovation requirements of the **future world of work**. The Appendices to this report provide an overview of ocean sciences academic programmes and qualifications offered by selected universities.
- Given the niche of the Ocean Sciences Campus as a hub for transdisciplinary research, innovation and postgraduate studies, it is proposed that Ocean Sciences be led by a **visionary intellectual** with the requisite scholarly stature and excellent networking capabilities.
- The Head of Ocean Sciences should report directly to the Deputy Vice-Chancellor for Research, Innovation and Internationalisation (DVC RII) as the **responsible executive management member** with dotted reporting lines to the other DVCs as it relates to matters pertaining to their portfolios.
- The ocean sciences governance model should enable collaborative partnerships with relevant internal and external stakeholders through a representative **multi-stakeholder advisory board** as a single point of convergence to inform and steer the University's Ocean Sciences Strategy.
- The Head of Ocean Sciences should serve as a broker to foster **mutually beneficial relationships** between the relevant research and engagement entities, research chairs and faculties. Executive Deans, faculties, research chairs and entities should own the Ocean Sciences strategy as an enabler of expanding their partnership footprint, attracting talented staff and postgraduate students, and improving research productivity and outputs. To facilitate such synergies, it is proposed that there be reciprocal **cross-**

representation of faculties and the Head of Ocean Sciences on the Ocean Sciences Advisory Board and Faculty Boards respectively.

- A **dual affiliation model** should be cultivated to enable academics and postgraduate students to contribute towards their home departments and faculties through undergraduate teaching and curriculum development, while also being affiliated with the Ocean Sciences Campus for the purposes of pursuing collaborative research, innovation and postgraduate studies.
- The University should develop a **revenue and cost sharing model** that is conducive to facilitating and incentivising inter- and transdisciplinary collaboration through mutual benefits for both the faculties and Ocean Sciences.

The above principles are diagrammatically represented below in terms of the proposed ocean sciences governance and management model:

The Head of Ocean Sciences will fulfil the role of leveraging existing and emerging institutional capabilities to foster innovative, transdisciplinary collaboration to position the University as a premier destination of choice for ocean sciences. This will be brokered and facilitated through a networked model in close collaboration with all faculties, as well as relevant research and engagement entities and research chairs.



1. The Head: Ocean Sciences will have a reporting line to the DVC Research, Innovation and Internationalisation, but dotted reporting lines to the DVCs Learning and Teaching, Engagement and Transformation and People and Operations for ocean sciences matters pertaining to these portfolios.
2. The designation of the Head: Ocean Sciences will be determined by the job analysis, position profile and job evaluation processes.

8. CONCLUSION AND WAY FORWARD

In conclusion, Nelson Mandela University is poised to optimise its first-mover strategic advantage as it relates to its positioning as a destination of choice for ocean sciences nationally and on the African continent. Through establishing the first dedicated Ocean Sciences Campus in South Africa and considerable efforts by our faculties, five ocean sciences research chairs, various research and engagement entities and the South African International Maritime Institute, the University has distinguished itself as one of the leading role players nationally. However, as a critical success factor, the implementation of the University's five-year ocean sciences strategy requires visionary governance and leadership to ensure that Mandela University can further entrench its competitive advantage in this domain. To this end, the recommendations made in this report serve as a platform for informing decisions relating to the design of an ocean sciences governance and

management model that best serves the transdisciplinary mandate of the University in the service of society.

As part of the way forward, the following next steps are envisaged:

- Consultation with the VC, DVCs and Deanery in respect of the proposed ocean sciences governance and management model with a view to promoting ownership and refining the recommendations.
- The recommendations to be embedded in the organisational redesign proposals to serve at the Executive Management Committee meeting in November 2020 for approval and onward submission to Council.
- HR and Finance to be consulted regarding the resourcing requirements of the proposed ocean sciences governance and management model, including the need for interim arrangements to provide institutional oversight until such time that the substantive head of ocean sciences is appointed.

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ANNEXURE A: MARINE SCIENCE AND TECHNOLOGY PROGRAMMES OFFERED BY NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Bachelor programmes (3 years):

- Biomarine Innovation
- Marine biology and aquaculture
- Biotechnology
- Food Technology
- Nautical Sciences
- Ship Design
- Shipping Management
- Product- and System Design

Master programmes (5 or 2 years):

5-years integrated Master	2-years Master
Marine Technology	Ocean Resources
Marine Structures	Ecosystems – Biology, ecology and biogeochemistry
Marine Cybernetics	Aquaculture
Marine Hydrodynamics	Harvesting
Marine Operations	Marine biotechnology
Marine Engineering	Aquatic food science
Marine Design and Logistics	Aquatic Food Production (Nordic)
Marine Resources and Aquaculture	Food and technology
Underwater Technology	Biology
Cybernetics and Robotics	Biotechnology
Navigation and Vessel Control Systems	Industrial chemistry and biotechnology
Proces Cybernetics	Environmental Toxicology
Robot systems	Natural Resources Management
Autonomous Systems	Management of Demanding Marine Operations
Fisheries and Aquaculture cybernetics	Product and Systems Design
System Technology and Safety	Ship Design
Biotechnology	Maritime Engineering (Nordic)
Chemical engineering and biotechnology	Coastal and Marine Engineering and Management (Erasmus)

ANNEXURE B: UNIVERSITY OF SOUTHAMPTON MARINE-RELATED COURSES

The University of Southampton offers a first-class marine and maritime portfolio - covering everything from marine biology, oceanography, and water resource management through to maritime archaeology, maritime law, and ship science.

Undergraduate Courses

Environmental Sciences

F900 BSc Environmental Science (3 years)
F903 BSc/MEnvSci Environmental Sciences with Foundation Year (4 years)
F902 BSc/MEnvSci Environmental Science (4 years)
F750 BSc Engironmental Management with Business (3 years)
F751 BSc Environmental Monitoring and Modelling (3 years)

Geography

F8F7 BSc Physical Geography with Oceanography (3 years)

Geophysics

F640 BSc Geophysical Sciences (3 years)
F660 MSci Geophysics (4 years)
F662 BSc Geophysics with Foundation Year
F661 MSci Geophysics with study abroad (4 years)

Management

N202 BSc Business Management (3 years)

Marine Biology

7N16 MSci Biology and Marine Biology (4 years)
F703 MSci Marine Biology (4 years)
F705 BSc Marine Biology with foundation year (4 years)
F7C1 BSc Marine Biology with Oceanography (3 years)
F704 MSci Marine Biology with study abroad (4 years)

Maritime Law

LLB (Hons) Maritime Law (M1M2) (3 years)
Mechanical Engineering
HH35 MEng Mechanical Engineering/Naval Engineering (4 years)

Oceanography

F7C1 BSc Marine Biology with Oceanography (3 years)
F700 MSci Oceanography (4 years)
F710 BSc Oceanography (single honours) (3 years)

F701 BSc Oceanography with foundation year (4 years)
F7R1 MSci Oceanography with French (4 years)
F7F8 BSc Oceanography with Physical Geography (3 years)
F702 MSci Oceanography with study abroad (4 years)

Ship Science

H518 BEng Ship Science with Foundation Year (4 years)
H510 MEng Ship Science with Foundation Year (5 years)
J640 BEng (Hons) Ship Science (3 years)
J641 MEng Ship Science (4 years)

Postgraduate Courses

Engineering and the Environment

MSc Energy and Sustainability (Energy, Resources and Climate Change) (1 year)
MSc Sustainable Energy Technologies (1 year)
MSc Environmental Pollution Control
MSc Water Resources Management
MSc Integrated Environmental Studies
MSc Marine Technology / General (2 years)
MSc Marine Technology / Marine Engineering (2 years)
MSc Marine Technology / Naval Architecture (2 years)
MSc Maritime Engineering Science

Geography

MSc Engineering in the Coastal Environment
MSc Sustainability

Maritime Archaeology

V400 MA/MSc Maritime Archaeology (1 year)

Maritime Law

LLM Maritime Law (1 year)

Ocean and Earth Science

MSc Engineering in the Coastal Environment (1 year)
MSc Marine Environment and Resources (2 years)
MRes Marine Geology and Geophysics (1 year)
MRes Ocean Science (1 year)
MSc Oceanography (1 year)

ANNEXURE C: UNIVERSITY OF PLYMOUTH MARINE AND MARITIME QUALIFICATIONS

COASTAL AND OCEAN SCIENCES

Undergraduate courses
BSc (Hons) Ocean Science and Marine Conservation (Full-time)
BSc (Hons) Oceanography and Coastal Processes (Full-time)
BSc (Hons) Ocean Exploration and Surveying (Full-time)
BSc (Hons) Geology with Ocean Science (Full-time)
BSc (Hons) Geography with Ocean Science (Full-time)

Postgraduate Courses
MRes Applied Marine Science (Full-time)
MSc Applied Marine Science (Full-time)
MSc Hydrography (Full-time)

ENGINEERING FOR THE MARINE ENVIRONMENT

Undergraduate courses
BEng (Hons) Civil and Coastal Engineering (Full-time)
MEng (Hons) Civil and Coastal Engineering (Full-time)
BEng (Hons) Marine Technology (Full-time)
MEng (Hons) Marine Technology (Full-time)

Postgraduate courses
MSc Coastal Engineering (Full-time)
MSc Marine Renewable Energy (Full-time)
MRes Marine Renewable Energy (Full-time)

MARINE BIOLOGY, ECOLOGY AND CONSERVATION

Undergraduate courses
BSc (Hons) Marine Biology (Full-time)
BSc (Hons) Marine Biology and Coastal Ecology (Full-time)
BSc (Hons) Marine Biology and Oceanography (Full-time)
BSc (Hons) Ocean Science and Marine Conservation (Full-time)
BSc (Hons) Ocean Sciences with Foundation Year (Full-time)
BSc (Hons) Conservation Biology (Full-time)
BSc (Hons) Environmental Science (Full-time)

Postgraduate research
MRes Marine Biology (Full-time)
MRes Applied Marine Science (Full-time)
MSc Applied Marine Science (Full-time)

MSc Environmental Consultancy (Full-time)
MSc Sustainable Aquaculture (Full-time)
MSc Sustainable Environmental Management (Full-time, Part-time route available)
MRes Sustainable Environmental Management (Full-time)

MARINE GEOSCIENCES

Undergraduate
BSc (Hons) Geology with Ocean Science (Full-time)
BSc (Hons) Geography with Ocean Science (Full-time)

COASTAL GEOGRAPHY AND MARINE POLICY

Undergraduate
BSc (Hons) Ocean Science and Marine Conservation (Full-time)
BSc (Hons) Geography with Ocean Science (Full-time)
BSc (Hons) Environmental Science (Full-time)

Postgraduate
MSc Environmental Consultancy (Full-time)
MSc Planning (Full-time, Part-time route available)
MSc Sustainable Environmental Management (Full-time, Part-time route available)
MRes Sustainable Environmental Management (Full-time)

INTERNATIONAL SHIPPING AND MARITIME BUSINESS

Undergraduate
BSc (Hons) Maritime Business and Logistics (Full-time)
BSc (Hons) Maritime Business and Maritime Law (Full-time)
BSc (Hons) Cruise Management (Full-time)
BSc (Hons) International Supply Chain and Shipping Management (Full-time)
BSc (Hons) Navigation and Maritime Science (Full-time)
FdSc Navigation and Maritime Science (Full-time)

Postgraduate
MSc International Logistics and Supply Chain Management (Full-time)
MSc International Procurement and Supply Chain Management (Full-time)
MSc International Shipping (Full-time)
MSc Business and Management (Full-time)

MARINE CULTURE

Undergraduate
BA (Hons) History (Full-time)
BA (Hons) Photography (Full-time)

BA (Hons) Media Arts (Full-time)

Postgraduate
MA History (Full-time)
MRes History (Full-time)
MA Maritime History

ANNEXURE D: UNIVERSITY OF WESTERN AUSTRALIA MARINE AND MARITIME QUALIFICATIONS

Bachelor of Science (Integrated Earth and Marine Sciences) and Master of Geoscience
Be at the forefront of creating a more sustainable future for our planet by gaining a holistic understanding of Earth and its oceans.
Level: Undergraduate
Type: Undergraduate Major
Area of interest: Science

Bachelor of Science (Marine Science) and Master of Marine Science
Gain specialised knowledge of marine life and a solid understanding of the physical processes across our coastal marine environments.
Level: Undergraduate
Type: Undergraduate Major
Area of interest: Science

Integrated Earth and Marine Science (Double Major)
This double major offers a research-led experience in studying the Earth, from the planet's early history to its foreseeable future, and from the ocean floors to its highest mountains.
Level: Undergraduate
Type: Undergraduate Major
Area of interest: Science

Marine Science (Double Major)
This double major will expose you to the full breadth of the marine science discipline, allowing deeper understanding of both the physical and biological components through the Marine Biology and Coastal Processes majors.
Level: Undergraduate
Type: Undergraduate Major
Area of interest: Science

Marine and Coastal Processes
Coastlines globally face unprecedented threats from continued development and climate change.
Level: Undergraduate
Type: Undergraduate Major
Area of interest: Science

Marine Science
If you are fascinated by marine and coastal environments, a Marine Science major could be for you.
Level: Undergraduate
Type: Undergraduate Major

Area of interest: Science Law and Business Computing, Maths and Engineering Education and Teaching Medicine and Health

Marine Biology
Marine biology is the study of marine organisms, and their behaviours and interactions with the environment.
Level: Undergraduate
Type: Undergraduate Major
Area of interest: Science

Master of Ocean Leadership
Develop the skills needed to work in a range of marine-related fields to strategically address human challenges in ocean systems.
Level: Postgraduate
Type: Masters by Coursework
Area of interest: Science Medicine and Health Computing, Maths and Engineering Law and Business

Master of Environmental Science
Experience an interdisciplinary approach to Environmental Science with a specialisation in one of Environmental Management, Marine and Coastal, Catchments and Water, Environmental Rehabilitation, Sensing and Environmental Data or Environmental Economics.
Level: Postgraduate
Type: Masters by Coursework
Area of interest: Science

Master of Biological Science
Western Australia (WA) is a marine and terrestrial biodiversity hot spot. Up to 80 per cent of the region's plants, marine fish and invertebrates are unique to the area. This makes WA the ideal living laboratory for studies in biological science.
Level: Postgraduate
Type: Masters by Coursework
Area of interest: Science

ANNEXURE E: AUSTRALIAN MARITIME COLLEGE QUALIFICATIONS

MARITIME ENGINEERING AND HYDRODYNAMICS

Undergraduate Courses

Bachelor of Engineering (Specialisation) with Honours
The four-year Bachelor of Engineering (Honours) degrees are accredited by Engineers Australia, the Royal Institution of Naval Architects (RINA), and the International Institute of Marine Engineering, Science and Technology (IMarEST). Students can choose from one of three Maritime Engineering specialisations, namely:

- Naval Architecture
- Ocean Engineering
- Marine and Offshore Engineering

Bachelor of Engineering (Specialisation) with Honours (Co-operative Programme)
This programme allows students to combine their studies with practical experience in their chosen specialisation to gain industry experience. Students alternate periods of full-time study with periods of full time paid work experience, but must maintain a credit average throughout their degree to remain in the programme.

Alternative entry pathways exist if students do not meet the direct entry requirements into the Bachelor of Engineering degrees.

Diploma of University Studies (Engineering)
The Diploma of University Studies (Engineering) is designed as an alternative entry pathway to university study. In this specialisation, students study units which provide the skills and knowledge related to their intended degree and are provided with additional support to maximise their chances of success. Completion of the Diploma will provide achievement at introductory level in two units.

Collaborative Degrees – Bachelor of Engineering 2+2 programme
AMC partners with several world class institutions within Australia and New Zealand, which provides students with the opportunity to experience two world class institutions with the Bachelor of Engineering 2+2 programme.
Collaborations exist with the following institutions:

- Flinders University, South Australia
- Edith Cowan University (ECU), Western Australia
- Auckland University of Technology (AUT), Auckland, New Zealand

Students complete the first two years of their degree on campus at the partnered university, with the final two years of the degree to be completed on campus at AMC.

GLOBAL LOGISTICS AND MARITIME MANAGEMENT

The Global Logistics and Maritime Management programmes prepare students for management and senior administrative careers in private enterprise, industry, and government.

Undergraduate Courses

Diploma of Global Logistics and Maritime Management

The Diploma of Global Logistics and Maritime Management has been developed to provide students with contemporary business expertise for careers in management and administration in the maritime and logistics industries and related areas.

This course also provides a pathway into the Associate Degree of Global Logistics and Maritime Management and the Bachelor of Global Logistics and Maritime Management.

Associate Degree in Global Logistics and Maritime Management

The Associate Degree in Global Logistics and Maritime Management provides students with problem-solving skills and knowledge of critical elements of both the logistics and maritime industries. Studying this course develops a range of skills that enhance decision-making and can be applied to complex issues that arise in international logistics systems and its associated maritime transport sector.

This course articulates from the Diploma of Global Logistics and Maritime Management and provides a pathway into the Bachelor of Global Logistics and Maritime Management.

Bachelor of Global Logistics and Maritime Management

Combining core business principles with maritime business and logistics produces a degree with a strong industry focus. This degree is designed to prepare students for management careers in the maritime and logistics industries.

The course is unique as it combines core business principles in finance, marketing, economics, business law and strategic management with logistics and specific maritime industry units of study including:

- Port and terminal management
- Ship operations management
- Maritime economics

OCEAN SEAFARING

Undergraduate Courses

These programmes integrate professional short courses with training at sea so students receive not only an Advanced Diploma or bachelor's degree, but also an Australian Maritime Authority (AMSA) Certificate of Competency (CoC).

These courses are also compliant with the training and educational requirements of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.

Bachelor of Applied Science (Nautical Science)
Prepares students for a career as a navigating (Deck) Officer and Master on commercial vessels.

Bachelor of Applied Science (Marine Engineering)
This course prepares students for a career as a Marine Engineer Officer on commercial vessels.

Bachelor of Applied Science (Marine Electrical Engineering)
This course prepares students for a career as a Marine Electro-Technical officer who manages and maintains shipboard electrical, electronic systems, control systems and marine electrical powering systems, including automation.

VOCATIONAL EDUCATION AND TRAINING (VET) SHORT COURSES

AMC provides a wide range of industry-focused, vocational education and training courses at all levels for students wishing to pursue a career in the maritime industry.

Maritime Operations and Coastal Seafaring

Courses available
Certificate I in Maritime Operations (General Purpose Hand Near Coastal)
Shipboard Safety Skill Set
Certificate II in Maritime Operations (Coxswain Grade 1 Near Coastal)
Certificate III in Maritime Operations (Master up to 24m Near Coastal)
Certificate IV in Maritime Operations (Master up to 35m Near Coastal)
Certificate II in Maritime Operations (Marine Engine Driver Grade 3 Near Coastal)
Certificate III in Maritime Operations (Marine Engine Driver Grade 2 Near Coastal)
Certificate IV in Maritime Operations (Marine Engine Driver Grade 1 Near Coastal)
Diploma of Maritime Operations (Marine Engineering Class 3 Near Coastal)
Certificate III in Maritime Operations (Integrated Rating)

POSTGRADUATE QUALIFICATIONS

AMC offers postgraduate opportunities in the following areas:

MARITIME BUSINESS AND INTERNATIONAL LOGISTICS

Postgraduate Courses
Graduate Certificate in Maritime and Logistics Management
Graduate Diploma of Maritime and Logistics Management

Master of Business Administration (Maritime and Logistics Management)
Master of Business Administration (Advanced) (Maritime and Logistics Management)
Master of Business Administration (Industry Specialisation)
Master of Logistics Management (Advanced)

ENGINEERING

Postgraduate Courses
Graduate Certificate of Maritime Engineering (Specialisation)
Graduate Diploma of Maritime Engineering (Specialisation)
Master of Maritime Engineering (Specialisation)
Master of Maritime Engineering (Maritime Design)

SEAFARING

The Master of Applied Science degree programme focuses on the maritime industries. Delivered by distance, the following specialisations are available:

- Shipping Operations Management
- Marine Engineering

The programme incorporates a Graduate Certificate and a Graduate Diploma as entry and exit points.

HIGHER DEGREES BY RESEARCH

AMC also offer Higher Degrees by Research programmes of study by a Master of Philosophy (MPhil) or Doctor of Philosophy (PhD). HDR programmes of study are possible across a variety of maritime-related areas such as:

- Surface and underwater vehicle hydrodynamics
- Ocean renewable energy
- Marine modelling
- Marine engine performance
- Fluid-structure interactions
- Maritime transport logistics
- Maritime safety including human factors
- Maritime emergency and crisis management

In addition, IMAS (Launceston campus) offers HDR programmes of study in the following research areas: Aquatic animal health, nutrition, and physiology; Fisheries management and technology; Marine biology and ecology; and Seafood Quality and Safety.

Master of Philosophy (MPhil)
A Master's degree normally takes from one to two years full-time, or up to four years part-time. MPhil candidates are required to complete one core and one elective from the **Graduate Certificate of Research**.

Doctor of Philosophy (PhD)

A PhD normally takes from three full-time, or up to eight years part-time. Candidates are required to submit a thesis, which makes a substantial, original contribution to the scholarly literature in their research.