Strategic Marine Alliance Research, Teaching and Training (SMART2)
A NATIONAL MASTER-LEVEL AT SEA TRAINING INITIATIVE

CHIEF PROONENT
Dr Leanne Armand, Dept of Biological Sciences, Macquarie University, NSW.

INITIAL UNIVERSITY CO-PROPOONENTS (IN PRINCIPLE)
Professor Richard Coleman and Professor Mike Coffin, Institute for Marine and Antarctic Studies, University of Tasmania, Tasmania.
Professor Neil Bose, Australian Maritime College, University of Tasmania, Tasmania.
Professor Iain Suthers, School of Biological, Earth and Environmental Sciences, University of New South Wales, N.S.W.
Dr Eleanor Bruce and Professor Elaine Baker, School of Geosciences, University of Sydney, N.S.W.
Professor William Gladstone, School of the Environment, University of Technology Sydney, N.S.W.
Assoc. Professor Michael Ellwood, Earth Environment, Research School of Earth Sciences, ANU, A.C.T.
Dr Sebastian Holmes, School of Science & Health, University of Western Sydney, N.S.W.

POTENTIAL INSTITUTE HOST FACILITY
Macquarie University via the Sydney Institute of Marine Science, NSW.

POTENTIAL VESSEL OF OPERATION
Marine National Facility RV Investigator

INTERNATIONAL ADVISORY SUPPORT
Dr Pauhla McGrane and Mr John Boyd, Strategic Marine and Research Training, GMIT, Ireland.
Mr Aodhán Fitzgerald, Research Vessel Programme Coordinator and Operation Manager, Marine Institute, Ireland.


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EXECUTIVE SUMMARY

SMART² NATIONAL MASTER-LEVEL AT SEA TRAINING

The Strategic Marine Alliance for Research, Teaching and Training (SMART²) is a contemporary, cross-institutional endeavour to develop and establish a national, postgraduate level, sea-going training programme. The goals are to provide Australian marine postgraduate students with relevant experience and training on the Marine National Facility RV Investigator by establishing a national standard syllabus, with the incorporation of an Australian Maritime Safety Authority (AMSA) approved sea safety and survival training certification. SMART² builds upon the experience of past sea-school activities run through the Australian National University and the University of Sydney and the modern experience of the Irish SMART programme and the Australian Maritime College, University of Tasmania.

Australian marine research has been significantly enhanced with the commissioning of a new research vessel the RV Investigator. This vessel is equipped with advanced marine surveying, sampling and analysing equipment enabling high-end, multi-disciplinary research opportunities by Australian marine and atmospheric scientists across Australia’s broad maritime claims (Antarctic and Southern Ocean - Tropics). The vessel is logistically coordinated by the Marine National Facility (MNF).

SMART² seeks to develop ship-based training on the RV Investigator in alignment with current developments in higher education postgraduate training. Specifically, it:

- Addresses the pressing need for postgraduate student training and accreditation at a national level by uniting higher education providers directly with the Marine National Facility.
- Facilitates educational expertise transfer and cooperation by formalising a participation platform between marine educators, institutes and government research bodies with a focus on student on-board exposure and training.
- Sets a framework for developing a national curriculum module that can be conducted regardless of port-to-port transits by integrating with National Collaborative Research Infrastructure Strategy Integrated Marine Observing System (NCRIS-IMOS) facilities.
- Seeks to establish short, two-week duration (summer or winter) schools enabling student involvement at the widest national level.
- Establishes a national level of quality training for students that can serve as an accreditation standard or expectation that is internationally benchmarked and recognized by the Irish SMART and EUROFLEETS2 programme.
- Aim for inclusion of Aboriginal and Torres Strait Island student training as a step beyond the Certificate 1 in Maritime Operations (Tribal Warrior Association administered).
- Acts as a common point of contact for future collaborative arrangements (e.g. for a student volunteer programme with MNF or Australian Antarctic Division missions based on completion of the course and AMSA certification attainment).
- Opens the possibility for future extension into the International postgraduate training market servicing University-based postgraduate exchange students or direct international interest.

In order to develop the initiative, a core group of Universities has agreed, in principle, to establish this proposal plan with the initial two fold objectives of:

1) confirming key external partner support (MNF, IMOS, Geoscience Australia, etc.) therefore, allowing advancement to the next stage;  
2) the submission of an Australian Office of Learning and Teaching Seed Grant to enable the core team and external partners to develop the national standard curriculum and run a trial voyage.

This scoping document outlines the background to the SMART² initiative in terms of the new and recently established Australian marine infrastructure that it aims to integrate; identifies a successful international program upon which an Australian national program can be based; summarises the national marine science policy and investment drivers from previous assessments; outlines the Australian Educational landscape for postgraduate training needs and how these are catered for; provides an operational plan detailing a draft syllabus that includes the potential to enhance existing infrastructure use and uptake; suggests potential SMART² governance and a host facility for the program; and finally, documents a pathway for capitalisation of the SMART² programme with an indicative milestone timeline from conception to the running of the first trial.

The proposal is an ambitious plan seeking long-term impact and commitment. The immediate outcomes of the training will be students with standard experiences and work-ready for internships, volunteer opportunities, PhD projects or employment. The long-term outcomes are a significant rise in our Australian marine student’s scientific outputs and reputations, improved and increased use of the scientific infrastructure invested in by the Australian Government (MNF and IMOS), and providing a platform for generational, institutional and industry knowledge transfer and collaboration.

All acronyms and abbreviations used in this document are listed in Appendix 1.
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CHAPTER 1

1. THE STRATEGIC MARINE ALLIANCE FOR RESEARCH, TEACHING AND TRAINING (SMART2)

1.1 BACKGROUND TO THE INITIATIVE

The Strategic Marine Alliance for Research, Teaching and Training (SMART2) is a cross-institutional marine science partnership programme designed to develop capacity in carrying out offshore research operations on board research vessels (RV Investigator) for Master-level students of marine-related science, engineering, technology, management, law and policy. SMART2 arose out of a cross-institutional desire to:

(i) develop an effective, efficient form of research vessel-based scientific teaching and training by pooling national tertiary teaching expertise and personnel resources.

(ii) standardise teaching protocols/methods and learning outcomes in this area in conjunction with the new data collection equipment and facilities of the RV Investigator.

(iii) provide a multi-disciplinary research-based teaching module for marine science postgraduates with opportunities for student mobility and network development.

Australia lacks a formal national body representing post-secondary marine science curriculum standards and educational interests with representation from government institutions and external industry or services as part of continuing professional development. Although Australia has, and many global consortia exist, under an educational banner, most are focused on primary and secondary education outcomes that focus on ocean conservation and environmental issue awareness and literacy (e.g. The Marine Education Society of Australia (MESA); U.S. Marine Science Education Consortium, U.K. Marine Technology Educational Consortium; EU, European Marine Science Educators Association (EMSEA); Pacific: International Pacific Marine Educators Network (IPMEN) etc.). The Australian Marine Sciences Association (AMSA) and the Australian Meteorological and Oceanographic Society (AMOS) can be viewed as the two bodies that best represent the peak scientific interests of marine research scientists and industry specialists, and provide strong student support.

In terms of curriculum development, individual state-based Boards of Studies have more detailed educational standards for the High School Certificate focused on Marine Science (e.g. Anonymous NSW, 2008; Anonymous WA, 2013) than those currently and potentially provided by individual and independent Australian Universities. With the recent implementation of the Australian Tertiary Quality Standards Agency (TEQSA; http://www.teqsa.gov.au/) individualistic University graduate and postgraduate course standards in marine science will be forced to revise and benchmark their knowledge infrastructure and outline the continuing professional development outcomes for graduates and postgraduates seeking marine careers. We believe that these new standard requirements reflect the national approach proposed by this specialised postgraduate-level programme, and furthermore link directly into recent national facility investments by the Australian Government (i.e. MNF, IMOS).

The Marine Nation 2025 report (Oceans Policy Science Advisory Group (OPSAG), 2013) reiterated a consistent feature raised through various Australian marine science state-of-affair synopses over the last decades (e.g. Bruce et al. 1997, Commonwealth of Australia 2008, 2011, 2012): the need for appropriate and consistent training in the next generation of marine scientists. Specifically, some reports highlight the need for coordinated efforts in research and training directed at amalgamating university and institutional expertise with access to cutting edge facilities and infrastructure (Bruce et al. 1997; OPSAG, 2013). Although such summary reports also focused on, and have successfully achieved, significant improvements in the coordination and nationalisation of marine infrastructure through targeted government funding (e.g. equipment & maintenance, centralised data, retrieval & end products, research vessels), the educational training aspects nationally have lagged in stark contrast. Yet remarkably, in assessing the success, implementation and uptake of the infrastructure via the various bodies (IMOS, MNF, NCRIS funded centres) one of the performance reportables to government departments (e.g. Dept. of Education, Dept. of Industry) includes the number of students undertaking postgraduate studies, using the data streams, or producing publications (e.g. IMOS 2014a). Although this expectation of output from students could be viewed as disingenuous, it can be reasoned that the major infrastructure injection and establishment was first required before any advance towards a coordinated national educational training standard could be formulated, implemented and value-added to the new infrastructure.

Marine Nation 2025 (OPSAG, 2013) identified that increases in Australia’s marine capabilities to respond to the national research, societal and environmental challenges relied on three interrelated components Skills, Infrastructure and Relationships (i.e. mechanisms for collaboration) (Figure 1.1). The report also highlighted the need for targeted initiatives to address the marine science education and training of the future workforce that would strike out beyond a single institution’s effort by uniting educators, industry and governments. It is within this broad and long-standing context in which the initial proponents here, outline the first step in achieving national postgraduate skills and certification by integrating with established marine national infrastructure, with the focused aim of increasing Australia's marine science capability.
Figure 1.1. Marine Nation 2025’s view of Australia’s marine science capability being composed of skills, infrastructure and mechanisms for collaboration (relationships). Source Marine Nation 2025 (fig. 2, OPSAG 2013).

The Chief Scientist of Australia’s recent report on Science, Technology, Engineering and Mathematics (STEM): Australia’s Future highlights education and training as one of the four critical strategic foci to Australia’s global economic future, whereby:

“Australian education—formal and informal—will prepare a skilled and dynamic STEM workforce and lay the foundations for lifelong STEM literacy in the community.”

(pg. 6, Office of the Chief Scientist 2014).

“The education system must ensure that students not only acquire knowledge, but also learn how to apply and adapt this knowledge to a variety of contexts. Students must have clear pathways from the classroom to a career in the STEM economy. Our needs and our capabilities must align.”

(pg. 21, Office of the Chief Scientist 2014).

Under these repeated national calls for action, the SMART² program aims to be a first decisive step in addressing our future marine science training needs on the national level.

1.2 MARINE NATIONAL FACILITY

Fund ed by the Australian Government since 1984 and overseen by an independent Steering Committee, the Marine National Facility (MNF) provides a keystone element of the nation’s research infrastructure by providing a blue-water research capability to Australian marine researchers and their international collaborators for work in Australia’s vast marine estate. The Facility is accessed through an independent and peer reviewed applications process focused on scientific and/or technical excellence, the potential to contribute to Australia’s national benefit and the ability of the investigators. This ensures the research undertaken through the MNF is specifically selected to contribute to Australia’s national benefit, and provide key information to government, industry and other stakeholders to support evidence-based decision-making focused on research challenges in fisheries management, geological resources, regional and global climate, coastal and offshore developments and marine operations.
To date, the MNF’s blue water research capacity has been delivered by the 66m RV *Southern Surveyor* and a suite of unique scientific equipment providing 30 years of marine data. However, in 2014 the MNF took delivery of a new purpose-built 94m multi-purpose research vessel *Investigator*, providing a step change in Australian marine and atmospheric research capability that will also act as a catalyst for international collaboration. The RV *Investigator* has greatly increased capacity over RV *Southern Surveyor* and can carry out voyages from the tropics to the Antarctic ice edge with up to 40 scientists on-board and spending 300 days per year at sea on voyages up to 60 days in duration. The RV *Investigator* also hosts an extensive suite of state of the art scientific research equipment and is one of a handful of research vessels globally designed for very quiet operation with the ability to undertake acoustic mapping and sampling to the deepest parts of our oceans.

The MNF is firmly committed to the training of future marine scientists and encourages the active involvement of student participation embedded within national and international scientific programmes. Since 2008, through their Next Wave Program the MNF has provided more than 120 students an opportunity to work and train on a multi-purpose research vessel to develop the next generation of Australian blue-water researchers. (Figure 1.2).

![Figure 1.2. Summary of student participation on the RV *Southern Surveyor* voyages from 2008/09 to 2011/12 (figure source pg 40, MNF Annual Report 2011/12).](image)

Furthermore, the MNF views opportunities under the Supplementary Application process (to use transit voyages or utilise spare capacity on scheduled voyages) as the avenue where proposals specifically directed at educational outcomes for future marine scientists can be accommodated within the National Benefits remit.

The MNF is yet to outline comprehensively their national training and educational drivers and priorities, however, under the Supplementary Application process (MNF 2014b) their current position can be considered foundational in that they seek to support applications focused on:

1. individually stylised training and educational programmes for onboard delivery integrated with campus-based studies.
2. individual students to apply for access when linked to existing research or training groups.
3. organised University/institutional marine science advanced short courses.

In all three cases the Supplementary Application process facilitates the development of skill sets or indeed extension of research opportunities to postgraduate students.

Capitalisation on the call to strengthen educational standards and provide certifications to Australia’s future marine science, technology and policy workforce is not a stated focus in which the current MNF priorities are specifically set, but one that they will increasing lean upon to assess future sea-going participants. The MNF acknowledges, and is committed to creating, a safe, health- and wellbeing-smart workplace on board any research vessel. Codes for personal behaviour, safety and biohazards are regulated by government and industry laws or standards implemented and annexed by the MNF with respect to the RV *Investigator*. Such standards are already clearly incorporated with the MNF Vessel Use Principals and included in requirements for pre-voyage medical screening. Yet other standards, such as Australian Maritime Safety Authority’s (AMSA) sea survival and safety training, will undoubtedly be considered a base national standard for all voyage participants into the future, as currently is the case for other marine industry operators and workers requiring entry Seafarers qualifications, such as a Certificate of Competency and/or General Purpose Hand ticket.

With the availability of the state-of-the-art MNF RV *Investigator* for use by the Australian marine community, the inter-institutional SMART2 multi-disciplinary, training voyage will provide:

- A simple coordinated, MNF-specific educational training experience organised through a cooperative range of independent higher education institutes (and government agencies/industry) with different strengths.
Central to the SMART2 objective of capacity building in the next generation of marine postgraduates is to provide a coordinated and national standard experience for students principally onboard the RV Investigator and with the participation of the MNF. It is from the the RV Investigator that many students will go on to use the vessel for future national and international research programmes, build new sampling or observational technologies or write marine or implement marine policies over the next 30 years. For most students their participation on a voyage will be their first experience of working within a marine industry-working environment. More often than not, their experience provides a decisive moment in defining their future career paths and setting their opinions of marine science issues and capabilities. The integrated alliance that we seek to build through SMART2 and the MNF underpins this first step in delivering a national strategy and addresses the Marine Nation 2025 declarations for:

“A stable, sustained and predictable commitment to maintaining, updating and transforming infrastructure, and the human resources to run it, is critical to ensure the initial investment in new infrastructure delivers long-term and sustainable benefits. Investment in human capability is also required: training, skills development, mechanisms and incentives for collaboration.”

(pg 5, OPSAG, 2013)

and those of the National Research Plan:

“Without a depth of basic research expertise, Australia: will not have the capacity to conduct basic research that impacts on unique Australian challenges such as sustaining our local terrestrial and marine ecosystems.”

(pg 12, COA 2012).

and finally those of Australia’s Chief Scientist:

“Ensure that the skills of STEM graduates are aligned with workforce needs through:

- fostering partnerships between schools, higher education institutions, training providers and employers
- using the partnerships to identify required STEM capabilities
- identifying the mutual responsibilities of industry and government in addressing supply and demand gaps.”

(pg 23, Office of the Chief Scientist 2014).

1.3 INTEGRATED MARINE OBSERVING SYSTEM

The Integrated Marine Observing System (IMOS) was established in 2006-07 and continues to be sustained by NCRIS and related government programmes through to 2015. Its mission is to:

“Undertake systematic, sustained, scientifically robust observation of Australia’s vast and valuable ocean estate and turn these observations into data, time series, products and analyses that can be used and reused for broad societal benefit.”

(IMOS 2014b).

Under their 2015-25 strategic plan (IMOS 2014b), IMOS seeks to mature into its second decade of activity through three core themes “Need, Capability and Impact”, which in turn represent nine priorities. Three priorities (6, 7 and 9) are opportunities representative of future IMOS engagement through their capability and impact themes aligned with the aim of this proposal.

Our focus here is to discuss the potential for the incorporation of some of IMOS’ infrastructure such as Satellite Remote Sensing, Australian National Mooring Network, Ships of Opportunity Program and the Australian Ocean Data Network (Figure 1.3). Ways in which these major facilities can be incorporated into the syllabus of SMART2 are detailed in Chapter section 2.2. A support letter for this initiative from the Director of IMOS is found in Appendix 3.

Figure 1.3. IMOS capability, from space to seafloor, open ocean to coast, physics to biology (figure source pg 6, IMOS 2014b).
1.4 THE IRISH SMART PROGRAMME - A SUCCESSFUL NATIONAL EXAMPLE

Ireland has a population of 6.4 million and has a marine territorial claim of over 890,308 km² and two national research vessels. In comparison, Australia has a population of 23.1 million and a total maritime claim of around 10 million square kilometres (Australian Government Geoscience Australia 2006) and one new research vessel. Research vessel-based training in Ireland has been in place since 1986, however, in 2008 the Marine Institute with the Higher Education Authority developed a pilot programme to coordinate the use of national infrastructure for training with a specific desire to increase national capacity, skills and expertise. The trial was successful and lead to the Strategic Marine Alliance for Research and Training (SMART), which commenced in 2011 by integrating five Higher Education Institutions with the Marine Institute and the Higher Education Authority to pool existing facilities, expertise and infrastructure to develop and deliver efficient, accredited, customised training programmes. SMART has since trained 300 marine-related undergraduate and postgraduate students annually on the RV Celtic Voyager and in 2014, ran 12 national and international training programmes, one of which is IMarEST (Institute of Marine Engineering, Science and Technology, http://www.imarest.org/) accredited.

Ireland and Australia have much in common being island nations with large marine territorial claims, and with limitations to the resources for national research and infrastructure. The Irish SMART programme is an excellent and successful example of a collaborative and integrated national marine training programme upon which Australian higher educational institutions and existing national facilities and institutes can model a new national educational framework and collaborative programme. Australia’s marine infrastructure resources are limited but expected to be inclusive, and whilst our marine expertise is diverse from the Tropics to the Antarctic, coasts to deep sea, and widely multi-disciplinary, it is dispersed institutionally. Our tertiary training standards need to take a momentous step forward by continuing educational training pathways for our future marine science workforce, making them nationally connected and internationally relevant, acknowledged and competitive. The success of the Irish SMART programme is instructive and achievable as a postgraduate model for Australia to emulate. To this end the Irish SMART programme and the Marine Institute extend their support for this initiative and encourage the Australian marine community to work together in developing this new capability-building, training initiative (Appendix 3).
2. SMART² PROPOSAL

2.1 THE SMART² MAST PROGRAMME

SMART² aims to produce a National Master-level At Sea Training (MAST) programme through which students, enrolled at any Australian Tertiary Educational Institution where marine science, technology and/or management/policy is offered at the Master-level (coursework or research based), could apply and be credited with an equally weighted unit completion toward their degree. Inclusion of PhD students, and the provision of credit towards the award of a PhD degree, may not be possible due to complexities across individual University degree structures, however, student participation would be possible and encouraged as an experience-based training and certification programme, where Master-level placements were not filled. Additional target users are identified in Chapter section 3.3.2.

An exemplar unit description including activity outline and an indicative syllabus is described below and borrows substantially (with permission) from the Irish SMART Multidisciplinary Offshore Operations Module programme (McGrane pers. comm. 2014). It is assumed that this draft exemplar will provide a solid base from which the current consortium can design the first National Standard curriculum on the MNF RV Investigator platform. The outline will serve as a basis for the Office of Learning and Teaching Seed Funding grant submission in June 2015.

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<tr>
<td>Credit</td>
<td>University Participant Agreed</td>
<td>Level</td>
<td>Master</td>
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**Unit Description**
This unit provides the student with detailed practical knowledge necessary to plan and participate in a multidisciplinary marine scientific research voyage, including the ability to maintain a log book, map a ship’s position, collect samples, process and analyses basic data, provide information for a cruise report and find and contribute data to the AODN. External AMSA safety and survival at sea certification is included and expanded on through specific MNF safety protocols and at sea etiquette.

**Target Students**
Multidisciplinary training assumes a prior knowledge and understanding in the subject areas of marine science and will be aimed towards postgraduate Master-level students across a wide spectrum of marine science subject areas.

**On-completion of the unit the student will be able to:**

1. Plan and participate in a multidisciplinary marine science research survey focusing on the core disciplines of e.g. oceanography, plankton ecology, geosciences, atmospheric and fisheries science.
2. Evaluate the physical, chemical and biological factors that influence the abundance and distribution of marine organisms using an IMOS National Reference Station (NRS) as an example.
3. Describe the application of various scientific sampling equipment and instrumentation onboard a survey vessel.
4. Acquire, process and analyse quantitative and qualitative samples.
5. Perform data analysis, quality control, interpretation and integration.
6. Prepare a final Cruise report integrating all data.
7. Prepare and present an element of the final cruise report to peers and crew.
8. Master the skills required to operate and conduct oneself safely in the marine environment including specific MNF sea survival skills.
9. Attain an AMSA sea safety and survival skills certification.
<table>
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<tr>
<th>Activity</th>
<th>Location</th>
<th>Potential Syllabus content</th>
<th>Workload est. hours</th>
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</table>
| On-line learning                             | Off-site                  | - On-line mission planning, surveying and general preparation (with SMART² programme trainer and MNF provided content).  
- Discipline content material with respect to particular mission. Could include basic taxonomic familiarisation on-line (e.g. plankton, zooplankton, fish).  
- AODN/IMOS on-line data access training. | 20-25               |
| Personal sea safety and survival training (certificate) | Approved AMSA 3rd party supplier | - Principles of Safety and Survival at Sea  
- Practical techniques for Survival at Sea | 10                 |
| Pre-mission planning                         | Classroom at location of departure | - Survey design, planning and participant duties.  
- Log book training and mapping.  
- Meeting with Scientific party, MNF Operations manager, Captain and relevant crew. | 10                 |
| Ship-based training (5-8 days dependent on transit distance/allocated time) | Vessel | Stage 1 (First day)  
- Scientific party tour of ship.  
- Ship-board specific safety training by crew.  
- Operations procedures of equipment by SMART²/MNF staff.  
Stage 2 (Rotation of groups over 3-5 days)  
- Data acquisition (inclusive of IMOS observations)  
- Sample collection and processing.  
Stage 3 (Last 1-2 days)  
- Data acquisition, processing and QC  
- Production of Cruise Report and summary presentation.  
- Sample packing and addressing (where required). | 10h/day (50-80)     |
| Post-mission demobilisation and data finalisation | Classroom at location of arrival | - Demobilisation from ship.  
- Completion of MNF Cruise Report and data preparation for AODN submission. | 10                 |
| Post-mission                                | Off-site                  | - Student feedback (on-line). | 1                  |

Indicative syllabus contents on the activities detailed above will be based on University and Key Stakeholder community involvement. Our aim is to have this community input supported through the OLT Seed Grant submission. The syllabus or nested nature of the unit within a Master degree offering would need to conform to Tertiary Education Qualification Standards Agency (TEQSA) and their Australian qualifications framework and take into account other recent Learning and Teaching Academic Standards (LTAS) development in Science (Jones et al. 2011) (Refer to Chapter section 3.1 Educational Landscape).

The following brief syllabus outlines are examples from the Irish SMART Multidisciplinary Offshore Operations Module. Our training missions would include additional operations that would be suitable to the basic exposure and use of equipment on board (e.g. intake line assessments, plankton tows, atmospheric sampling, marine mammal and bird watching). Details related to the potential integration of relevant IMOS facilities are covered in the Chapter section 2.2.
SMART Multidisciplinary Offshore Operations Module Indicative Syllabus Content

Survey Planning and Design (Shore-based or E-learning module)
1. Principles of Survey Design and Planning
2. Practical survey design and development of plan
3. Attend pre-cruise meeting with research vessel personnel

Personal Sea-survival Training (Shore-based)
1. Principles of Survival at sea
2. Definitions, survival craft and appliances
3. Personal Life-saving appliances (Lecture and Demonstrations)

Vessel familiarisation and orientation
1. Onboard etiquette
2. Onboard safety tour
3. Vessel Activities and capabilities

Oceanography
1. Configuration and operation of oceanographic equipment and instrumentation.
2. Process CTD water samples for a range of samples according to standard protocols.
3. Plankton identification and main taxonomic groups; productivity protocols.
4. Data processing, formatting and presentation.

Marine Geosciences
1. Familiarity with equipment and instrumentation used to acquire geophysical data (multibeam, side scan sonar etc.)
2. Acquisition of geophysical data including survey line planning.
3. Acquire and process marine sediment sampling.
4. Process and presentation of geophysical data for scientific reports.

Benthic ecology
1. Familiarity with equipment used for benthic sampling.
2. Demonstrate competency in the deployment of benthic sampling equipment.
3. Onboard processing of sediment and faunal samples.
4. Recording data and the completion of data logs.

Fisheries science
1. Rationale behind fisheries science.
2. Onboard sampling instrumentation and equipment and their uses.
3. General techniques for genetic analyses of biological materials; use of the rad-van.
4. Analysis and formatting of basic biological data.

Post-survey data analysis and integration (Shore-based)
1. Data acquisition processes.
2. Quality control of data.
3. Data analysis and interpretation.

2.2 POTENTIAL IMOS FACILITY INCORPORATION INTO THE SYLLABUS.

Four IMOS facilities have the potential to be integrated within the SMART-MAST syllabus as relevant to the sampling, information source, visualisation and data management training platforms. The relevance and contributions of these four IMOS facilities are detailed below.

2.2.1 SATELLITE REMOTE SENSING (SRS)

Three key satellite data-streams are the focus of IMOS investment. Australia does not have satellites, but we contribute data to aid in the calibration and validation of satellite data in the Australian region, and products are also developed from raw satellite data. These data streams includes Sea Surface Temperature (SST) data, Sea Surface Height (SSH) and Ocean Colour (OC) (IMOS 2014c).

Instruments detecting sea surface temperature can highlight different bodies of water associated with ocean currents, and the speed of currents and eddies, while the satellite altimeter measurements generate the equivalent of atmospheric pressure measurements (highs and lows). From these data scientists can infer where the currents are likely to be flowing (IMOS 2014c).
Additionally the IMOS OceanCurrent website uses a broad range of IMOS observations including SSH, SST, profiling buoys (ARGO), radar and glider data and are shown in graphical form for immediate interpretation by a wide range of users (IMOS 2014c).

Data from this facility and in particular the use of the OceanCurrent website in the SMART2 training voyage can be employed to provide the following:

- Basic training of students on the information provided by satellite remote sensing.
- Interpretation and use of the information provided by the OceanCurrent website to identify particular oceanographic features such as eddies, upwelling, etc.
- Use of this information for cruise planning and sampling by looking at the latest satellite information and target regions with oceanographic features of interest.
- Exposure of Master-level students to the SRS time series with the aim of increasing awareness and potential project use of data in the future.

2.2.2 AUSTRALIAN NATIONAL MOORING NETWORK (ANMN)

The National Mooring network measures physical and biological parameters of Australian coastal waters, and consists of a number of components including a network of National Reference Stations (NRS) some with CO₂ moorings and passive acoustic observatories and regional shelf mooring arrays.

The NRS network represent Australia’s coastal time series observational data platform sustained by both moored sensors and monthly vessel based sampling (NRS 2011). The NRS network goal is to:

“develop multi-decadal time series of the physical and biogeochemical properties of Australia’s coastal seas, to inform research into ocean change, climate variability, ocean circulation and ecosystem responses”

(p. 7, NRS 2011).

Currently seven NRS are in operation around the continent, building on three long-term locations where monthly water sampling for physical and biological parameters have been in operation since the 1940’s. In total 58 data streams are delivered by the NRS and include temperature, salinity, dissolved oxygen, nutrients, turbidity, carbon, biological parameters for both phytoplankton and zooplankton and an optical proxy for chlorophyll a. CO₂ moorings are co-located at some NRS sites to collect parameters used to characterise the concentration of CO₂ in the water.

Regional shelf moorings are deployed in a wide range of configurations and are designed to characterise and monitor regional processes on the continental shelf. In some places, shelf moorings are linked to deep water transport arrays. Parameters measured include oceanographic data and current velocity from Acoustic Doppler Current Profilers, with some moorings collecting biogeochemical data as well.

The consistent physical and biogeochemical variables routinely collected by the ANMN facilities mean that where SMART2 training voyages intersect with such moorings, the following could be provided:

- Basic training of students in the collection of routine physical and biogeochemical samples following standard national protocols developed by the NRS (e.g. Ingleton et al. 2011, 2014, Critchley 2012).
- Exposure of Master-level students to the ANMN facility and time series objectives with the aim of increasing awareness and potential project use of data in the future.
- Contribution of an additional data set to the time series.
- Contribution of additional sampling samples/data (i.e. geological, atmospheric, biological) at or nearby the NRS, using specialised equipment available on the MNF RV Investigator.

2.2.3 SHIPS OF OPPORTUNITY PROGRAM (SOOP)

Ships Of Opportunity Program is an international effort that implements a network of cargo, ferry and research vessels to deploy scientific instruments that collect ocean observations. Australia is one of the largest contributors to this program. Underway air-sea fluxes, sea surface temperature, bioacoustics, and biogeochemical data will be measured on the RV Investigator.

The biogeochemical sensors collect high quality partial pressure of CO₂ (pCO₂) and fugacity of carbon dioxide (fCO₂) measured in surface seawaters. SST measurements are made using hull contact SST sensors on a broad range of platforms, yielding high quality in situ near real time SST observations. The air-sea flux facility collects rare meteorological and surface ocean observations for bulk flux measurements of heat, mass and momentum in data sparse regions of the ocean. The bio-acoustics (BA) data involves the use of echo-sounders to estimate mid-trophic level organism distribution and abundance around the Australian Exclusive Economic Zone (EEZ) shelf, slope and oceanic environments. Data from this program could be incorporated into the SMART2 training voyage and thus provide the following: Basic training of students in the collection of underway data on board the RV Investigator

- Exposure of Master-level students to the different SOOP sensors, the type of data collected and time series objectives for each dataset with the aim of increasing awareness and potential project use of data in the future.

2.2.4 THE AUSTRALIAN OCEAN DATA NETWORK (AODN)
The AODN is the national repository for all marine data having been developed initially from six government departments in 2005. Since 2010 the IMOS eMarine Information Infrastructure (eMII) has been charged with the responsibility of maintaining and continuing the development of the AODN for the benefit of Australian institutes, scientists and the general public. The AODN brief is twofold: 1) enhancing contributions through a culture of data sharing, and 2) facilitating the discovery and accessibility of the data available. The AODN technical advisory group is currently addressing the latter by realigning the technical vocabulary within and across the AODN database with the specific aim of facilitating discoverability of all collected marine data. On the former point, the AODN recently highlighted the need to instill positive attitudes to data sharing from the initiation of any new initiative with a principal focus on bringing awareness of such reform to undergraduate and master-level students (AODN 2014). In the past the AODN has conducted both standard (data access) and bespoke workshops as part of degree courses or familiarisation events across the country (AODN 2014). Our proposal aims to ensure that integration of both familiarity with the AODN portal, data visualisation and the process of data contribution is integrated with our programme’s objectives. Therefore, the inclusion of AODN as part of the SMART2 training will provide the following:

- Exposure and training in the basic data search of the AODN portal, using SOOP, ANMN and/or SRS facilities as examples.
- Collection and preparation of metadata from the survey that is compliant with the Marine Community Profile of the ISO 19115 standard, for incorporation into the AODN.
- Development of a national data awareness, accessibility and submission standard for students that can be referred to on CV’s, and is preferable to future employers.
- Integration of IMOS eMII/AODN personnel within the SMART2 voyage, which broadens the educational training brief of IMOS.
- Provide a student base for the AODN to test developing accessibility implementations.

### 2.3 MARKETING PLAN

SMART2 would be unique in the Australian marine educational and training space. A national approach would be required with clear branding and website presence, assisted and approved by the MNF. Co-badging with clear co-sponsorship levels, pre-determined by the SMART2 committee, in place.

### 2.4 MARKETING

#### 2.4.1 ADMINISTRATION COSTS

There will be costs related to the Administration of SMART2.

- SMART2 will be established under a partnership agreement managed by Macquarie University. The administrative support for the programme will be provided by an Executive Officer HEW Level 6, 5 days/week, $82,647 (including oncosts). The role of the Executive Officer will be to co-ordinate all finance, communication and engagement activities between partners of the SMART2 program (e.g. SMART2 Steering committee and Management groups) and assist with training at sea. The Executive Officer will be supported by a Research Officer HEW Level 5, 3 days/week, $55,729 (including oncosts). The role of the Research Officer will be to co-ordinate with the MNF all logistical activities related to ship time and co-ordinate training in consultation with the SMART2 Academic Advisory group.
- Administering costs - to be found initially via the 2 grant applications with some indicative support by interested partners (e.g. in-kind salary or cash), however, eventually University and external partner buy-in support at set amount (i.e. similar to IODP or other ventures) will need to help sustain the program after pilot stages. The aim is also to actively seek external industry sponsorship as part of an educational teaching and training investment or equity scholarship support.
- Mobility of training staff - accommodation/ flights/ sea-pay/ insurance/ freight etc. - would need to be covered by individual institutions as part of agreement of being involved in the national initiative.
- Marketing/Branding/Website/Social Media of SMART2 will need to be integrated into on-going costing of the post-pilot stage and would need to be compliant with MNF and Macquarie University.
- Insurance of students while at sea through their home-enrolled University and the MNF.

#### 2.4.2 STUDENTS’ COSTS

There will be costs for Students undertaking SMART2.

- Course enrolment fee - needs to determined through negotiation with University partners involved. Use cross-institutional SIMS model as example.
• AMSA sea safety training- external cost and dependent on location of student’s institution to the closest 3rd party approved agency where the certification is undertaken by the student. Could be subsidised by University postgraduate participation schemes. Is likely to be an external cost to student. Could be claimed on tax if educational expenses remain a claimable expense (tax advice required).
• Flights to/from departure points of ship - could be argued into the OLT grant assistance whilst trialing the initial 3 years. Post-funding could be subsidised by University postgraduate participation schemes. Will be an external cost to student. Will actively seek industry sponsorship as part of an educational investment - special support scholarship programme.
• Medical - currently covered by MNF and dependent on voyage duration.
• WHS Clothing requirements- hard toe-covered work boots, coveralls/jackets, gloves and eye protection glasses. Hard-hats should be MNF supplied.

2.5 ADVERTISING AND PROMOTION

Our primary aim is to use the MNF as national redirect portal. We list the potential national and international means by which the unit could be advertised. Incorporating such advertising would incur some minor costs in terms of travel, surveying and analysis and web development and maintenance.

• National:
  o University Posters/Presentations incorporating positive student feedback.
  o Australian Marine Sciences Association (AMSA) advertising (wide marine student base), e-mail posters and presentation.
  o Website hosted at MQ.

• Redirection through AODN and IMOS websites:
  o International (well down the track).
  o Website.
  o Specific university exchange programmes with agreed unit attainment.
CHAPTER 3

3. EDUCATIONAL FRAMEWORK AND MARKET ANALYSIS

3.1 EDUCATIONAL LANDSCAPE

Australian tertiary educational standards are now being revised in line with the Department of Education’s Tertiary Quality Standards Agency (TEQSA). TEQSA are now mandating changes in line with discipline organised Learning and Teaching Academic Standards (LTAS). At present there is no specific LTAS guideline for science-based Master programmes, nevertheless the guideline for Science degree Honours students (i.e. Jones et al. 2011) can be used as a departure frameworking guide in which to place the national marine science Master unit envisioned by SMART’s MAST unit. Our aim is to ensure that we provide a basis for continuing professional development outcomes for graduates and postgraduates seeking marine careers. In the long term, these standards, if benchmarked internationally, along with the SMART MAST programme itself, could be certified internationally by IMarEST (Institute of Marine Engineering, Science and Technology), which upholds and acknowledges continuing professional development through their membership levels.

3.1.1 EMERGING TRENDS

The Science, Technology, Engineering and Mathematics report (Office of the Chief Scientist 2014) made specific recommendations to:

*Increase workforce ability in the sciences through:*

- Mechanisms that explain the opportunities of STEM engagement to business and encourage employment of STEM practitioners
- Supporting the widespread adoption of work-integrated learning models, including: exchanges between business and research organisations incentives for education institutions to include work placements for credit in most degrees and training programmes.
- Targeted support to increase the STEM participation of women, disadvantaged and marginalised students, including Indigenous students.*

(pg. 24, Office of the Chief Scientist 2014).

Equally, the Office of Learning and Teaching lists the following (selected) driver priorities into 2015/16, through which future funding is based and in which the SMART initiative could choose to address.

a. Academic standards

Applications under this priority area should be collaborative, strategic projects that complement the most recent work undertaken by the Higher Education Standards Panel (HESP) and the HESP Research Fellow, taking into account the operations and requirements of the Tertiary Education Quality and Standards Agency (TEQSA). Projects should also take into consideration the outcomes of the Learning and Teaching Academic Standards (LTAS) project, and other OLT projects that have extended these LTAS projects.

b. Employability skills

Applications under this priority area should be national, collaborative projects across higher education institutions, industry, and professional bodies.

Applications should address key issues such as:

1. The distinctiveness of Australian higher education institutions in preparing graduates to be globally employable
2. Pedagogical approaches that appropriately blend academic and practical learning experiences, delivering learning outcomes that see students prepared for work with the right mix of practical and theoretical/academic skills
3. Building reciprocal and collaborative relationships between employer, industry and professional bodies and institutions
4. The relationship between good-practice learning and teaching processes, learning outcomes and employability
5. The role of higher education institutions in preparing the graduates of the future for employment, and how to embed this in the curriculum
6. Curriculum design and assessment for work-ready graduates.

c. Improving institutional pathways across higher education

Applications should propose to develop and model strategies for one or more of the following:

- Inter-institutional and cooperative partnerships between all types of institutions at the tertiary level, including through tailored learning that best meets students’ needs now and connects students with the learning needs of tomorrow
- Maximising successful transitions between different types of tertiary providers
- Better transitions between the vocational education and training sector and the higher education sector
- Developing and modelling programmes that work with schools to improve participation in higher education
- Pathways to professional qualifications, to doctoral qualifications, or to other postgraduate study, or research pathways.
d. Improving access to and outcomes in higher education for Aboriginal and Torres Strait Islander people

Applications should propose projects which respond to the relevant recommendations of the Review of Higher Education Access and Outcomes for Aboriginal and Torres Strait Islander People. Projects should also take into consideration relevant other OLT projects and fellowships.

3.1.2 SMART2’S UNIQUE SELLING POINTS

The implementation of the SMART2 initiative has the following unique selling points within the Australian Marine educational environment.

- Unique in Australia.
- Cross-institutional.
- Develops a clear pathway for employability standards in the marine scientific workforce.
- Uses established national infrastructure specifically for educational and training purposes in a nationally organised manner.
- Contributes to marine science research.

3.1.3 BARRIERS TO ENTRY

At this early stage of development there are three major barriers to entry:

- Initial funding to develop national syllabus and governance.
- Cross-institutional support.
- Sea-time allocation on the MNF RV Investigator.

All three, however, can be addressed and overcome, providing the aim of creating a united national cross-institutional program remains at the centre of decisions made to advance this initiative. Given that this is the first time that a concerted national approach to postgraduate training has been undertaken, we believe we can be successful in attracting Seed Funds to provide the training framework and demonstrate its need, student interest and outcome success. In-principle cross-institutional university support has been provided as a result of this document’s generation. Informal support for the initiative has received through scoping meetings with major institutional bodies, resulting in direct support letters from one facility and two end users (Appendix 3). The final barrier, dedicated ship-time will depend on the deliberations and endorsement by the MNF Steering Committee in early 2015. The MNF’s support is critical to the success and future direction of the initiative.

3.2 COMPETETIVE ANALYSIS

3.2.1 AUSTRALIAN EDUCATIONAL ENVIRONMENT-COMPETITION

Australia does not have a national at-sea scientific training program. Historically, prior to the 1990’s, Australia’s marine science students were more likely to have been involved in local research voyages where experience and training was provided principally through exposure. Geoscience Australia’s precursors, the Bureau of Mineral Resources (BMR) and Australian Geological Survey Organisation trained students through summer internships or Honours-PhD level research sea-based programme integrations, as has CSIRO Marine and Atmospheric Research. Most students, however, would have learned on the job from more experienced scientists and seamen, and staff at such institutions made a point of taking university students on national or foreign expeditions (pers. comm. 2014, Dr N. Exon, ANZIC).

3.2.2 OTHER PAST APPROACHES

a. CSIRO RV Southern Surveyor Next Wave programme

As briefly outlined in Chapter section 1.2.1, projects were welcomed for the training of students from the University sector through the “Next Wave – tomorrow’s marine scientists” transit voyages on the RV Southern Surveyor. Student integration across all types of scientific and Next Wave voyages provided training to over 120 students since 2008/09 through to 2011/12. This program has been discontinued and has been replaced by the MNF’s Supplementary Application process.

b. UNESCO School of the Sea

The University of the Sea, established by Professor Patrick De Deckker and Professor Elaine Baker, was resourced principally by institutional

Photo courtesy: Leanne Armand, 2014.
support in conjunction with International Ships of Opportunity arrangements (i.e. the French RV Marion DuFresne) or the ARC Research Network for Earth System Science/Research Support (Baker et al. 2008 University of the Sea research program - Training students & global research) (Table 1).

The aim of the “University of the Sea” was to enable senior researchers from the region and overseas to work with young local scholars on marine issues of direct interest to the Asia-Pacific region. Students addressed specific regional problems (including those unique to tropical and sub-tropical countries) through a programme of targeted research. Students attended a series of lectures while at sea, worked with research staff and had to produce a poster before the end of the cruise on specific topics that were assessed by staff. The University of the Sea bought in a total of 56 Australian and 41 students from the Asian Pacific region in the six years of its operation and was successful in receiving ~$210K in support funding to assist with its operation (Table 1). The funding arrangements and engagement by the Toyota Foundation and UNESCO ensured there was no inequality in a student’s ability to participate in the University of the Sea by covering their airfares, transfers, insurance for the international students, medicals, port costs (hotels, food), visas and safety gear for the international students. Funds were also used to support a part-time administrator. Unlike the University of the Sea, SMART² aims to be foremost, a national student training program. The consortium has expectations that costs to participate will be incurred by students (Chapter section 2.4) via their course enrolment, nevertheless the consortium will seek in the long-term to provide mobility support via external industry partner scholarships.

Table 3.1. University of the Sea participation and funding data over its operation (Data source; pers. comm. E. Baker, 2015).

<table>
<thead>
<tr>
<th>Year</th>
<th>Research Vessel</th>
<th>Australian Students</th>
<th>Asia-Pacific Students</th>
<th>Total Funding in that year</th>
<th>Funding Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Marion Dufresne</td>
<td>7</td>
<td>11</td>
<td>$71,319.00</td>
<td>Toyota Foundation, IOC UNESCO</td>
</tr>
<tr>
<td></td>
<td>(French)</td>
<td></td>
<td></td>
<td>$6,848.00 (US$5K)</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>Marion Dufresne</td>
<td>10</td>
<td>9</td>
<td>$3000.00</td>
<td>Aust. national commission for UNESCO, Asia Pacific Network for Global Change</td>
</tr>
<tr>
<td></td>
<td>(French)</td>
<td></td>
<td></td>
<td>$25,000.00</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Tangaroa</td>
<td>10</td>
<td>4</td>
<td>$10,000.00</td>
<td>Australian Earth System Science Network, IOC UNESCO, Geoscience Australia</td>
</tr>
<tr>
<td></td>
<td>(New Zealand)</td>
<td></td>
<td></td>
<td>$5,883.00 (US$5K)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$25,000.00</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>Sonne</td>
<td>2</td>
<td>4</td>
<td>$10,000.00</td>
<td>Australian Earth System Science Network</td>
</tr>
<tr>
<td></td>
<td>(Germany)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008/9</td>
<td>Sonne</td>
<td>3</td>
<td>4</td>
<td>$50,000.00</td>
<td>Geoscience Australia</td>
</tr>
<tr>
<td></td>
<td>(Germany)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Southern Surveyor</td>
<td>22</td>
<td>2</td>
<td>$3,000.00</td>
<td>Ausaid PSLP grant ( part contribution)</td>
</tr>
<tr>
<td></td>
<td>(Australia)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>L'Atalante</td>
<td>-</td>
<td>3</td>
<td></td>
<td>As above</td>
</tr>
<tr>
<td></td>
<td>(France)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td><strong>56</strong></td>
<td><strong>41</strong></td>
<td><strong>$210,000.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

3.2.3 CURRENT APPROACHES

Today, there are several Master programmes from various Universities that focus specifically on producing training adapted to various marine industries, management or policy/law, however, there is no specific at-sea training program or full course dedicated to scientific research activities at sea. Several maritime-specific masters courses in ship management, engineering, safety, policy, operations and logistics are currently available (for example at the Australian Maritime College in Tasmania, the Challenger Institute of Technology, Western Australia and the University of Wollongong, NSW) and the offering of the SMART² master unit may be seen as a welcome option rather than as direct competition to existing specialised Master degrees.
a. ANZIC Marine Geoscience Masterclass.

In 2013, the Australian and New Zealand IODP Consortium (ANZIC) funded the first customised national undergraduate Marine Geoscience Masterclass workshop in Perth hosted by CSIRO, Curtin University and the University of Western Australia (ANZIC Annual Report 2013). The workshop’s aim was to inspire 20 high achieving second year undergraduate students into considering careers in marine geoscience, with a particular focus on the four science plan themes underpinning International Ocean Drilling Programme (IODP) activities. Students rated the specialist workshop highly (Talukder 2013) and the impact of the course was illustrated through the student feedback survey, which clearly indicated that the students were positively impacted and were more curious about a future career research within marine geosciences. Students appreciated being able to go to sea for a half day and gain practical experience in the collection of seafloor sediments. The course was held again in 2014 and and top students were selected by the 17 participating universities (N. Exon, pers. comm. 2014) to attend. Favourable reviews seeking additional hands-on data collection and handling were again highlighted by students attending the 2014 course (Exon/Talukder pers. comm. 2015).

3.3 MARKET ANALYSIS

3.3.1 SIZE OF THE MARKET

Australia’s postgraduate market for marine science, engineering, technology, policy, law and management is currently unknown and has not been documented in previous ‘state of the market’ surveys. Such data would need to be compiled and released by the Department of Education or the Australian Bureau of Statistics. We are well aware that the young generation of students show a great interest in many aspects of blue water research and when asked would jump at the chance for such training opportunities.

A limitation to the market-size accommodated by the SMART2 programme, aside from obtaining ship-time, is ship berth availability. The RV Investigator can support up to 40 scientists and support staff. Thus in all likelihood, with a single dedicated transit voyage, between 20-30 students could participate in SMART2 training per year. The University of the Sea figures indicate that an average of 13 students/year participated (Table 3.1), whilst the MNF trained 30 students/year (Figure 1.2). Therefore, we believe our number of 20-30 students per year is sustainable. If demand exceeds places, competitive selection criteria may need to be designed and implemented taking into account diversity and university staff contributions to training.

3.3.2 TARGET CUSTOMERS

SMART2 principally focuses on Master-level students as their target training cohort so that their course participation can be incorporated and accredited into various marine-based Master training programmes around the country. However, it is envisioned that access to the following cohorts:

- Honours students
- PhD students
- Exchange students (within advanced marine programmes at an Australian University)
- High-School Science teacher integration programmes (MNF/AAD)
- Tribal Warrior indigenous training additional pathway stage, would be possible where places are available. It is possible that the demand for the course may be higher than anticipated and only when the programme has been piloted and assessed can recommendations on size, timing and cohorts be addressed.

Photo courtesy: Leanne Armand, 2014.

We believe, given the lack of any current marine science student data, that student values and priorities for undertaking the training would be:

- Need to follow a national articulated pathway of professional development and certifications for future employment no matter whether in research (minor) or externally (majority) within industry/government, teaching, tourism etc.
- National and international bench-marked recognition of skills.
- Increased multi-disciplinary knowledge and experience base.
- Development of synergies and networks with cohort and potential employers.
- Retain and develop relevant skills in Australia.
- A pathway for inclusion of Aboriginal and Torres Strait Island student training as a next step beyond the Certificate 1 in Maritime Operations (Tribal Warrior Association administered).
3.3.3 POTENTIAL INTERNATIONAL MARKET

Although not an initial priority in the development and implementation of SMART², there is potential to broaden our intake into the neighbouring nations in the Australasian region. External involvement would be dependent on demand nationally, international interest and other administrative and cost factors that would need more detailed assessment beyond the scope of this current initiation phase. Support through other Australian Government Agencies such as AUSAID may also assist with the broadening of the program to neighbouring nations.

a. International Exchange potential

Potential for exchange with University of Hamburg Masters students has been already been raised between Macquarie University and the University of Hamburg inclusive of the involvement of training staff exchanges.

Another potential exchange may be possible with the Abijan Convention – the West African regional seas, who are also looking to start a similar programme with the Norwegian ship the RV *Fritjof Nansen*.

Certification of Australian Masters students on our benchmarked SMART2 programme could then apply for additional training programmes offered by SMART in Ireland or indeed make them eligible for EUROFLEETS2 experiences (e.g. http://www.smartseaschool.com/content/eurofleets2).

3.3.4 TARGET END USERS

Our focus is very much on the national capability development for future generations and the increased skill and experience base for employers to select from. Support letters from potential end users are located in Appendix 3. Below we highlight the major end users of SMART².

1. Master-level students - At the heart of this initiative is the capability-development of our students and future marine science workforce, starting with Master-level students.

2. Future employers - looking for skill certifications and experience.
   - University PhD project selection
   - Government research/institutes (e.g. Geoscience Australia, Australian Antarctic Division, CSIRO, IMOS etc.)
   - Industry (e.g. Offshore exploration, Environmental assessments, Aquaculture, Fisheries, Technology R&D companies)
   - Local, State and Commonwealth Government (e.g. Fisheries, Environmental impacts, Management and Policy, Education, Industry, R&D)
   - Teaching and Training careers
   - Tourism

3. MNF or AAD volunteer marine science mission opportunities (provision of certified and sea-experienced volunteers).

4. Industry, Government or Institute Internship programmes.
CHAPTER 4

4. INITIATIVE TEAM AND GOVERNANCE

4.1 INITIATIVE TEAM

The SMART² initiative team is lead by the Chief Proponent, Dr Leanne Armand, Macquarie University, and has eight university-based co-proponents representing the experience of past sea-school activities run through the Australian National University and the University of Sydney and representatives of the Sydney Institute of Marine Science. The co-proponents are:

- Professor Richard Coleman and Professor Mike Coffin, Institute for Marine and Antarctic Studies, University of Tasmania, Tasmania.
- Professor Neil Bose, Australian Maritime College, University of Tasmania, Tasmania.
- Professor Iain Suthers, BEES, University of New South Wales, NSW.
- Dr Eleanor Bruce and Professor Elaine Baker, School of Geosciences, University of Sydney, NSW.
- Professor William Gladstone, University of Technology Sydney, NSW.
- Assoc. Professor Michael Ellwood, Earth Environment, Research School of Earth Sciences, ANU, ACT.
- Dr Sebastian Holmes, University of Western Sydney, NSW.

Brief biographies outlining the background and expertise of the initiative team can be found detailed in Appendix 2.

4.2 POTENTIAL INSTITUTE HOST FACILITY

An example of how the programme could be run nationally is exemplified by the cross-institutional Master of Marine Science and Management through the Sydney Institute of Marine Science (SIMS), NSW.

The SMART² pilot programme could be conducted through SIMS’ established Master of Marine Science and Management programme with Macquarie University as the lead administrator, and governed initially by the co-proponents, representatives of the national facilities (MNF, IMOS) and other government agencies engaged in this proposal (e.g. GA, AAD).

4.3 EXTERNAL INTERNATIONAL ADVISORS

4.3.1 DR PAUHLA MCGRAKE

Marine and Freshwater Research Centre, Galway-Mayo Institute of Technology, Ireland.

Dr Pauhla McGrane is the Director of Ireland’s Strategic Marine Alliance for Research and Training (SMART) programme. She has a background in Biological Oceanography, focussing on the ecology and distribution of calcareous nannoplankton in the northeast Atlantic. She has been involved in a number of European Framework Programmes and was assistant work package leader on HABIT (Harmful Algal Blooms in Thin Layers), EUROFLEETS I and II and the IOC/SCOR Research Programme GEOHAB (Global Ecology and Oceanography of Harmful Algal Blooms).

She was the National Coordinator of the Marine Institute’s Integrated Marine Exploration Programme (2007-2009), the National Research Shiptime Programme (2009-2010) and the Strategic Marine Alliance for Research and Training (SMART) consortium (2011-present). Since 2007 she has led and acted as Chief Scientist and onboard oceanographer on over 100 National and International offshore training programmes including the International SMART-AWI Atlantic Summer School (2014). Pauhla serves on the Scientific Advisory Board of the Biological Institute of Helgoland, a Marine Research and Training centre of excellence of the Alfred Wegener Institute for Polar and Marine Research (AWI). She is also a member of the European Marine Board Working Group on Marine Graduate Education & Training.

(A support letter from SMART’s Dr McGrane is found in Appendix 3).

4.3.2 MR JOHN BOYD

Marine and Freshwater Research Centre, Galway-Mayo Institute of Technology, Ireland.

John Boyd is a course developer and chief scientist on SMART offshore training courses. Within SMART John is responsible for mobilizing and delivering offshore training on a wide range of offshore training courses. Among the accredited offshore training courses John has been instrumental in developing are the Applied Marine Biological Sampling and Data Collection Module, Science@Sea and the Common Module in multidisciplinary marine science for undergraduate and postgraduate students. John’s background is in fisheries science, sampling and
exploratory fisheries in the North Atlantic. In this capacity John has served as national data correspondent to a number of ICES and ICCAT stock assessment working groups.

4.3.3 MR AODHÁN FITZGERALD
Marine Institute, Ireland.

Aodhán Fitzgerald is the Research Vessel Programme Coordinator and Operation Manager who is responsible for the management, development and promotion of the state’s research vessels, specifically the R.V. Celtic Voyager, the R.V. Celtic Explorer and the Holland I Deepwater ROV. He works within the the Marine Institute’s Ocean Science & Information Services (OSIS) which as a team: secures external opportunities for Irish vessels at home and abroad; supervises and oversee the contract held by P&O Maritime Services Ltd who are the contractors responsible for manning and management of the vessels and the ROV; manages the diplomatic clearance process for the vessels as well as inputing to the permitting process for foreign vessels in Irish waters; and runs the Foreign Vessel Observer Scheme. (A support letter from the Marine Institute’s Mr Aodhán Fitzgerald is found in Appendix 3).

4.3.4 HAMBURG UNIVERSITY, GERMANY
Dr Kay Emeis, Dr Kai Jensen and Dr Justus van Beusekom. This team of researchers are interested in the potential for Master and teaching staff exchanges made available through the SMART² programme.

4.4 OTHER RESOURCES

Macquarie University’s Learning & Teaching Programme within the Faculty of Science and Engineering was the financial supporter of this initiative in 2014. The Pro-Vice Chancellor of Learning, Teaching and Diversity supports this initiative and the subsequent submission of the OLT Seed Grant administered by Macquarie University (Appendix 3).

4.5 EXPERTISE CONCERNS

SMART² builds upon the experience of past sea-school activities run through the Australian National University and the University of Sydney and the modern experience of the Irish SMART programme and the Australian Maritime College, University of Tasmania.

We acknowledge that there are competencies that we may currently lack in the initiative team such as:
- Marine Meterologist - BOM or University
- Marine Physical Oceanographer - CSIRO
- Social Scientists (Marine Policy/Law/Management)
- Marketing

However, it is our intention during the development phases to incorporate appropriate expertise should the initiative be successful after the pilot stage. Equally, external industry targets for future involvement include:
- mining and exploration companies
- software developers used by MNF
- fisheries/ aquaculture
- mapping/surveyor businesses
- renewable energies
- Australian Navy

4.6 PROPOSED GOVERNANCE STRUCTURE

It is not the aim of the current proposal to set out the full governance of the future SMART² programme. Our aim is to attract Australian National funding to support the development of the national programme and assist in definition of future governance. The latter depending on future external engagement. Below are lists of the initial and potential future governance structures for SMART².

4.6.1 INITIAL SETUP

- SMART² Activation and Grant Submission Committee (all agreed initial proponent universities, MNF and IMOS, and external agencies who agree to support and input to grant proposal e.g. Geoscience Australia).

4.6.2 POST-AWARD

SMART² would need to define something like the following, as exemplified by the successful Irish SMART programme:
- SMART² Steering Committee (includes rep from engaged universities, MNF and IMOS, external government agencies or industry, SMART² Management and Academic group heads and independent chair).
- SMART² Management Group (Head, Coordinator/Trainer, Administrator/Trainer).
- SMART² Academic Advisory Group (rotating representatives from all organisations interested in training development/assessment etc.)
CHAPTER 5

5. FINANCIAL PLAN

5.1 CAPITAL SUPPORT TO DATE

5.1.1 INITIAL SUPPORT

Macquarie University’s Learning and Teaching Grant to Dr Leanne Armand and Dr Pauhla McGrane (2014) provided funding ($3.5K) to help develop the plan, visit the existing programme in Ireland (SMART and the Marine Institute), and establish a core group of universities (at first SIMS-associated Unis, UTAS (IMAS and AMC), ANU), institutes (Geoscience Australia, AAD), and key facilities (MNF, IMOS) that will partner a submission for seed funding to the Office of Learning and Teaching.

5.2 CAPITAL REQUIREMENTS

Over the next 6 months capital support will be required, and be approved most likely, in terms of in-kind salaried support through chief and co-proponent time in preparing the OLT Seed grant submission.

During this submission time, proponents of the OLT Seed Grant submission consortia will need to detail the institutional co-funding (see next section) in support of the application. This may be in terms of cash, in-kind personnel time, support for mobility and accommodation at organised meetings for syllabus development, brand development and website hosting, etc.

Future capital funds, post-pilot project and OLT grant funding stages, will need to be determined and sought through both participation level and external sponsorship avenues.

5.3 FUNDING SUPPORT PLAN

5.3.1. FUNDING PLAN

To initiate SMART², the only Government educational-supported avenue appropriate to this national consortia and the need to develop an appropriate syllabus is through the Australian Office of Learning and Teaching (OLT) grants. Although several grants appear relevant, our best approach is to first seek a Seed Grant to provide the pilot, followed up with either an OLT Extension Grant or more appropriate OLT Innovation and Development Grant with wider national participation and consultation. Below we document the two stages anticipated to fund this initiative, through excerpts of the two programmes. Macquarie University would lead the submission.


Stage 1: OLT Seed Grant

Seed Grants support pilot projects, which test and evaluate an original idea, or stand-alone, small-scale project, or projects that build the capacity of early career academics. Applications can address any of the priorities for Innovation and Development Grants. Up to $40K per grant (total pool $600K) and are supported for 1 year.

Seed projects are expected to receive institutional support in addition to the OLT funding.

2015 Seed grants are only open in Round 2 and close on the 22nd June 2015 (5pm).

Our SMART² initiative would fall under their “Collaborative Projects” description: Seed projects can involve partner institutions but this is not a requirement. Applications from consortia will need to be submitted under a lead institution which must be a higher education institution eligible to receive a grant under the Australian Government Other Grant Guidelines. The lead institution must ensure each named collaborating institution/organisation has agreed to have its name put forward as a collaborating institution before submitting a project proposal. Failure to ensure the agreement of named collaborating institutions/organisations may result in the application being rejected by the OLT.

The lead institution must be authorised to act on behalf of all members of the consortia or collaborative group, and enter into agreements, which are binding on them. For the purposes of the application, all consortia members and the lead institution should be clearly identified.

Formal collaborations or partnerships must be acknowledged in documentation regarding the project. Collaborating institution(s) will contribute substantially to the project, usually through a project team member. To acknowledge this commitment, project proposals must be
endorsed in writing by way of a letter of endorsement from the DVC (Academic) or equivalent, of lead and collaborating/partner institutions before submission.

**Stage 2: OLT Innovation and Development Grant**

Innovation and Development Grants support research, development and innovation related to the enhancement of learning and teaching in higher education (for normally 2 to a maximum of 3 years). The applications can address a wide range of priority areas, including academic standards, the contemporary PhD, and improving access and outcomes for Aboriginal and Torres Strait Islander people in higher education.

Closing dates: Round 1: expressions of interest and full proposals, received via the online Grants Portal, rules available in August 2015 listed as closing in late November 2015.

Round 2: is only open to full proposals invited from successful expressions of interest in round 1 and Seed Projects. These proposals must be received via the online Grants Portal, no later than 5pm (AEST/AEDT), Monday 22 June 2016.

Funding: $5.5 million (indicative), between $40,000 and $500,000 per Innovation and Development grant

**5.4 RISK, REWARDS AND SUPPORT**

The forward-looking report from Australia’s Chief Scientist states:

“Global and domestic experience confirms that the risk of innovation can be spread through collaboration. The benefits include increased productivity, profitability and targeted export markets. In particular, collaboration between businesses and research organisations more than triples the likelihood of business productivity growth.”

“Our systems should focus a substantial part (not all) of our research effort on real national goals, whilst encouraging industry engagement and rewarding both excellence and impact.”

(pg. 16,17 Office of the Chief Scientist 2014).

The development of SMART2 has small risks and very large rewards if a concentrated and positive effort by a core team is invested in getting it off the page and into the water with strong external institutional support.

**5.4.1 RISKS**

- If grants fail then re-assessment will be required on funding support to keep momentum going. May require smaller working party and PVC of Learning and Teaching support across engaged Universities.
- Lack of broad National University support in round 2.
- The Sydney Institute of Marine Science does not wish to host the programme.

**5.4.2 REWARDS**

- Setting of an Australian marine educational standard at Master-level relevant to new TEQSA requirements.
- Significantly increased prospects and relevant experience for students.
- Will unite effort across the educational sector.
- Will provide a new level of training across the marine sector that can be used for internships and volunteer opportunities.
- Could become national success leading to bespoke modules and international interest.
- Will provide accountability data for National Facilities directed specifically towards student training.

**5.4.3 INITIAL COMMUNITY SUPPORT**

During the initiation and draft stages of this programme’s development positive support was been received specifically from the co-proponents, Dr P. DeDeckker, Dr Neville Exon, executive and special project staff of the MNF, IMOS, Geoscience Australia and the Australian Antarctic Division. Formal support for the initiative has already been provided by the Irish SMART program, IMOS, Geoscience Australia and the Australian Antarctic Division (Appendix 3). Additional institutional support letters that will aid in the submission of the OLT Seed Grant will be sought as a result of the release of this scoping document.

**5.5 EXIT STRATEGY**

If funded by OLT (for both rounds and trialled for 3 years) and full assessment indicates the programme has not obtained its educational aims or expectations then it can be revised or discontinued as an offering by the consortium with the option for one of the partners to take it up alone and resubmit as an independently-run institutional programme reverting back to being supported independently by the Supporting Applications programme of the MNF when opportunity arises.
## 6. MILESTONES

### 6.1 INDICATIVE TIMELINE AND MILESTONES

#### 2014

<table>
<thead>
<tr>
<th>June</th>
<th>July</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQ L&amp;T Grant Awarded</td>
<td>Initial Co-proponents in-principle sign on</td>
<td>Visit to SMART Coordinator and Marine Institute in Ireland</td>
<td>Business plan for SMART2 drafted by Armand</td>
<td>Draft released to co-proponents. Meetings with Facility Directors and interested Government institutions. Armand to report back to MQ Learning and Teaching- end of funding.</td>
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</table>

#### 2015

<table>
<thead>
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<th>Feb</th>
<th>April-May</th>
<th>22nd June 2015</th>
<th>Dec/Jan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last call for feedback and sign on to OLT grant submission</td>
<td>Preparation of OLT Seed grant. Meetings with partners. Endorsement letters sought.</td>
<td>Submission of OLT Seed Grant</td>
<td>Outcome of Seed Grant expected.</td>
</tr>
</tbody>
</table>

#### 2016

<table>
<thead>
<tr>
<th>1 Feb 2016</th>
<th>Easter break</th>
<th>July</th>
<th>Sept-Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed grant officially commences</td>
<td>1st workshop of National Consortium to develop syllabus. Special request to MNF for Transit Trial Voyage in early 2017</td>
<td>Submit MNF Supplementary Voyage request. At AMSA 2nd (closed) workshop to finalise syllabus and present overview to wider Marine Community</td>
<td>Final OLT report draft devised with outcomes, trial voyage planned. Website designed. Draft of OLT Innovation and Development Grant - open invitation for wide marine community involvement. If Transit voyage approved advertise to Master students for trial voyage.</td>
</tr>
</tbody>
</table>

#### 2017

<table>
<thead>
<tr>
<th>Jan 30</th>
<th>Jan-April</th>
<th>April-May</th>
<th>June 2017</th>
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CHAPTER 7
7. CONCLUSION

The SMART initiative is based in the urgent educational and training needs of Australia's marine scientific, engineering, technology, management, law and policy workforce. The initiative is a small, but transformational, step forward in addressing these needs by pooling marine academic, institutional and national facilities in a coordinated manner to provide a national certified training skill development experience as part of continuing professional development in the higher tertiary environment.

This document seeks support from government institutions and national facilities to advance this cause and support the OLT Seed Grant funding required to draw interested parties together to develop the national syllabus and run a pilot course. The first step in this process is to request special trial voyage time from the MNF on the basis of this scoping document. Only with this support established can the initiative be set in motion.

There are minor risks involved in the set-up and trialling of this programme, but considerable long-term rewards for students through to employers via this Strategic Marine Alliance Research, Teaching and Training initiative.

Photo courtesy: Martin Ostrowski, 2014

ACKNOWLEDGMENTS

Macquarie University’s Learning & Teaching Programme within the Faculty of Science and Engineering was the financial supporter of this initiative through a grant to Dr Leanne Armand and Dr Paulia McGrane. Feedback on draft versions were provided by P. McGrane, P. DeDeckker, N. Exon, M. Herberstein, the MNF, IMOS, Geoscience Australia and the Australian Antarctic Division. Macquarie University administrative assistance was provided by L. Staas, M. Howitt and P. Sukari from the Dept of Biological Sciences, Faculty of Science and Engineering.
REFERENCES


MNF (2014b) Advice to applicants: supplementary application for sea time RV Investigator voyages in 2015-16 and 2016-17. http://www.mnf.csiro.au/~media/Files/Applying%20for%20sea%20time-Supplementary/Supplementary%202015-16%20and%202016-17/Advice%20to%20applicants%20Supplementary-FINAL%2020141120.ashx


APPENDIX 1

APPENDIX 1 – ACRONYMS
AAD – Australian Antarctic Division
AMC - Australian Maritime College
AMOS - Australian Meteorological and Oceanographic Society
AMSA - Australian Marine Sciences Association
AMSA - Australian Maritime Safety Authority
ANMN - Australian National Mooring Network
ANU - Australian National University
ANZIC - Australian & New Zealand IODP Consortium
AODN - Australian Ocean Data Network
ARC - Australian Research Council
BMR - Bureau of Mineral Resources
CSIRO - Commonwealth Scientific and Industrial Research Organisation
EAC – East Australian Current
eMII - eMarine Information Infrastructure
EMSEA - European Marine Science Educators Association
GA - Geoscience Australia
HESP - Higher Education Standards Panel
IMarEST - Institute of Marine Engineering, Science and Technology
IMAS - Institute for Marine and Antarctic Studies
IMOS - Integrated Marine Observing System
IPMEN - International Pacific Marine Educators Network
LTAS - Learning and Teaching Academic Standards
MAST - Master-level At Sea Training
MESA - Marine Education Society of Australia
MNF - Marine National Facility
NCRIS - National Collaborative Research Infrastructure Strategy
NRS - National Reference Station
NRS - The National Reference Station
OC - Ocean Colour
OLT – Office of Learning and Teaching
OPSAG - Oceans Policy Science Advisory Group
OSIS - Ocean Science & Information Services
SIMS - Sydney Institute of Marine Science
SMART - Strategic Marine Alliance Research and Training
SMART+ - Strategic Marine Alliance Research, Teaching and Training
SOOP - Ships of Opportunity
SRS - Satellite Remote Sensing
SSH - Sea Surface Height
SST - Sea Surface Temperature
STEM - Science, Technology, Engineering and Mathematics
TEQSA - Australian Tertiary Quality Standards Agency
UNEP - United Nations Environment Programme
UTAS – University of Tasmania
APPENDIX 2

APPENDIX 2 – INITIATIVE TEAM

The initiative team is made up of the Chief Proponent, Dr Leanne Armand, and eight university-based co-proponents representative of the Sydney Institute of Marine Science, the University of Tasmania and the Australian National University. Brief descriptions of their background and experience are provided below.

A2.1. CHIEF PROPOINENT

A2.1.1 DR LEANNE ARMAND
Department of Biological Sciences, Macquarie University, NSW.

Dr Leanne Armand is an expert in Southern Ocean diatom taxonomy (the identification of marine microscopic phytoplankton). She has a strong interest in the distribution of individual species related to the physical oceanic environment, and the subsequent preservation of this environmental relationship in the fossil record to provide palaeoclimatic conditions. Dr Armand joined the Department of Biological Sciences, in the Faculty of Science and Engineering, at Macquarie University in 2009 as a Centre of Research Excellence appointee to Climate Futures at Macquarie. She was the Director of the Marine Science undergraduate programme (2010-2013), is the course convenor of BIOL121 (Marine Biology and Ecosystems), co-convenor of the Advanced Biology Program (BIOL188 and BIOL388) and supervises PhD and Master students. Prior to her current appointment, Dr Armand held postdoctoral positions at the Antarctic Climate and Ecosystem CRC in Hobart. While there, she was the first Australian awarded an European Union Incoming Marie Curie Fellowship, which she undertook at the University of Marseille in collaboration with Professor Bernard Quéguiner. In 2007 Dr Armand was awarded the Australian Academy of Science's Dorothy Hill award for her excellence in palaeoceanographic research and also the Bigelow Laboratory's Rose-Provasoli award. Dr Armand completed her PhD in 1998 at the Australian National University. She currently holds national and international committee representative positions on ANZIC, ANZIC-ECORD and IMPRESS-ISOLAT, which are all focused on maintaining and strengthening Australia's presence in international palaeoceanographic research opportunities for students and researchers alike.

A2.2 INITIAL UNIVERSITY CO-PROPOINENTS (IN PRINCIPLE)

A2.2.1 PROFESSOR RICHARD COLEMAN
Institute for Marine and Antarctic Studies, University of Tasmania, TAS.

Professor Richard Coleman, Deputy Director and the Associate Dean of Research at the Institute for Marine and Antarctic Studies (IMAS) at the University of Tasmania, is a physical oceanographer and glaciologist. He is also Director of the ARC SRI for Antarctic Gateway Partnership. From 2009-mid-2012, he was Executive Director, Physical, Mathematical and Information Sciences, at the Australian Research Council (ARC). He has over 30 years' experience as a researcher and academic in the Australian university sector, supervising to completion some 32 PhD and 5 Masters students. Following his PhD in marine geodesy at the University of New South Wales, he worked at the School of Earth Sciences, The Australian National University (1980-83) as a Queen's Fellow in Marine Science; ARC Research Fellow at the Ocean Sciences Institute at the University of Sydney (1983-85); lecturer/senior lecturer at the School of Civil and Mining Engineering, The University of Sydney (1986-1993); the University of Tasmania (1993-2009; Sept 2012-). From 2004-mid-2009, he was Director of the Centre for Marine Science and Director of the UTAS-CRSIRO Joint PhD Program in Quantitative Marine Science. He has participated in 5 marine cruises (oceanography and marine geoscience) from tropics to Southern Ocean and been the CI on a summer field expedition on the Amery Ice Shelf (Nov 2002-Feb 2003). He is a member of the Marine National Steering Committee and member of the National Committee of Earth Sciences, Australian Academy of Sciences.

A2.2.2 PROFESSOR MIKE COFFIN
Institute for Marine and Antarctic Studies, University of Tasmania, TAS.

Professor Mike Coffin, Executive Director of the Institute for Marine and Antarctic Studies at the University of Tasmania, is a marine geophysicist. His research expertise encompasses interactions between the oceanic environment and the solid Earth. Educated at Dartmouth College (AB) and Columbia University (MA, MPhil, PhD), he has pursued an international career that reflects the boundless nature of the global ocean. Following university studies, he has worked at Geoscience Australia (1985-1989), the University of Texas at Austin (1990-2001), the University of Tokyo (2001-2003), the Japan Agency for Marine-Earth Science and Technology (2002-2003), the UK’s University of Southampton and National Oceanography Centre (2007-2010), and the University of Tasmania (2011-). He has also held visiting positions Dartmouth College (1982), the University of Oslo (1992, 1996), Geoscience Australia (2000), France’s University of Strasbourg (2001), and the University of Hawaii (2002). From 2003-2005, he served as the inaugural chair of the Science Planning Committee of the Integrated Ocean Drilling Program, the largest international programme in the Earth and ocean sciences, and among the largest in any scientific discipline. Professor Coffin has lead or participated in 30 blue-water research expeditions, focusing mainly in the Southern, Pacific, and Indian oceans.

A2.2.3 PROFESSOR NEILBOSE
Australian Maritime College, University of Tasmania, TAS.
Professor Neil Bose is the Principal of the Australian Maritime College (AMC), a specialist institute of the University of Tasmania, and a Professor of Maritime Hydrodynamics. From 2009 to 2011 he was Director of the AMC – National Centre for Maritime Engineering and Hydrodynamics at AMC. Professor Bose obtained his B.Sc. in Naval Architecture and Ocean Engineering from the University of Glasgow in 1978 and his Ph.D. also from Glasgow in 1982. He came to AMC in Tasmania in May 2007 as the Manager of the Australian Maritime Hydrodynamics Research Centre. His personal research interests are in marine propulsion, autonomous underwater vehicles, ocean environmental monitoring, ocean renewable energy, ice/propeller interaction and aspects of offshore design. Professor Bose is an ocean engineer and naval architect with an international reputation in marine propulsion built up through close collaboration with international industry. Through his International Towing Tank Conference (ITTC) work, he is recognized as having contributed to new ways of looking at marine powering performance prediction, an approach, which is described in his 2008 book Marine Powering Prediction and Propulsors published by the Society of Naval Architects and Marine Engineers, USA.

A2.2.4 PROFESSOR IAIN SUTHERS
School of Biological, Earth and Environmental Sciences (BEES), University of New South Wales, N.S.W.

Iain Suthers leads an ARC Linkage Project with DPI (Fisheries) on Sydney’s Offshore Artificial Reef (2012-2014); and an ARC Discovery Project on zooplankton and fisheries (2015-2017). He and his team were awarded two ARC Large Infrastructure and Equipment Grants in 2011 for a Laser Optical Plankton Counter, and a DIDSON acoustic camera. He has just completed three ARC Discovery projects on salps, krill and eddies of the EAC. He led the first scientific trial on the Investigator in mid November 2014. He has led or participated in 12 research voyages on Australia’s Marine National Facility (RV Franklin and RV Southern Surveyor) into the Coral Sea, EAC and Tasman Front. He has organised or led 3 transit voyages on RV Southern Surveyor as envisaged in this proposal. He has supervised over 5 PhDs and 4 honours specifically on the Marine National Facility (and supervising in total 22 PhD completions). He leads a small laboratory (www.FAMER.unsw.edu.au) of 6 PhD and 2 MSc students in collaboration with Dr Jason Everett, Dr James Smith and Dr Nick Payne.

Iain was leader of the NSW node of Australia’s Integrated Marine Observing System www.imos.org.au (from 2007-2011); he has been one of the major drivers in the development of the Sydney Institute of Marine Science (www.sims.org.au); and contributed to the design and build of Australia’s new Research Vessel Investigator. He teaches a third year fisheries and oceanography course, contributes to the 2nd year Vertebrates and Biology of Invertebrates courses; to the 4th year honours programme. Of particular relevance is the development of the Masters of Marine Science and Management programme at SIMS, with the capstone course analysing the IMOS data streams.

A2.2.5 DR ELEANOR BRUCE
School of Geosciences, University of Sydney, N.S.W.

Dr Eleanor Bruce coordinates the Marine Science and Management postgraduate coursework program and is Deputy Node Leader for SpaceNet at the University of Sydney. Eleanor’s research interests are in coastal management, environmental spatial analysis and modelling, biophysical coastal process response to sea level variation, estuarine sedimentation modelling, marine species distribution and marine spatial planning. She is currently involved in a World University Network project examining the water-energy-food-livelihood security nexus for marine and coastal environments in collaboration with the Asia Pacific Network and International Institute for Water Management, CGIAR.

A2.2.6 PROFESSOR ELAINE BAKER
University of Sydney, N.S.W.

Professor Elaine Baker holds the inaugural UNESCO Chair In Marine Science at the University of Sydney. She is also the Director of the GRID-Arendal office at the University. GRID-Arendal is a centre collaborating with the United Nations Environment Programme (UNEP). The Government of Norway established the centre in 1989, with a mission to communicate environmental information to policy-makers and facilitate environmental decision-making for change.

Elaine, in collaboration with Professor Patrick De Decker from ANU, established the UNESCO supported University of the Sea, which ran from 2004 to 2011. The programme allowed more than 100 marine science students from the Asia Pacific region to participate in international marine research. She is currently involved in setting up a similar programme in conjunction with the Abidjan Convention in West Africa.

Elaine is currently involved in maritime boundary research particularly focused on supporting developing states finalise maritime boundaries in accordance with UNCLOS. She is working on a number of European Union and Norwegian funded projects that examine the responsible use of non-renewable resources, the economic evaluation of biodiversity and other ocean services, and the regulation and governance of ocean space. She is also involved in developing integrated marine assessment capacity building activities to support developing states participate in the United Nations World Ocean Assessment.
A2.2.7 PROFESSOR WILLIAM GLADSTONE
School of the Environment, University of Technology Sydney, N.S.W.

Professor William (Bill) Gladstone is a marine biologist with research and teaching interests in marine conservation biology, fish behavioural ecology, and marine environmental management. A major focus of Bill’s teaching has been the involvement of students in solving environmental issues to deepen field and classroom learning, and the excellence of these initiatives has been widely recognized through many teaching awards from the Dean, Vice-Chancellor, Carrick Institute, and the National Trust.

Bill combines his academic career with work in the profession and has worked on many major national and international projects including outbreaks of crown-of-thorns starfish on the Great Barrier Reef, the Torres Strait Baseline Study (both for the Great Barrier Reef Marine Park Authority), management of international networks of marine protected areas in the Red Sea and Gulf of Aden (for the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden PERSGA) and the Sulu-Sulawesi Sea Marine Ecoregion (for WWF), and the Strategic Action Programme for the Red Sea and Gulf of Aden (a Global Environment Facility project). He regularly works in the Port Stephens-Great Lakes and Batemans Marine Park. Bill has been Head of the School of the Environment since 2010. Prior to starting work at UTS in January 2010, Bill was Associate Professor in the School of Environmental and Life Sciences, and Deputy Director (Research) of the Central Coast campus of the University of Newcastle.

Bill is active in the Australian Marine Sciences Association (AMSA), being a Past President of the NSW Branch (2007-09) and a member of NSW Branch Council (2009-15). With his AMSA colleague Professor David Booth, Bill developed in 2008 the NSW AMSA Position Statement on Marine Protected Areas and No-Take Sanctuary Zones, which supported the scientific evidence underlying the usefulness of marine protected areas for biodiversity conservation. Bill’s membership of other professional associations includes: Australian Society for Fish Biology, Ecological Society of Australia, Royal Zoological Society of NSW, and the Society for Conservation Biology.

Bill was recently invited (by the Commonwealth Minister for the Environment) to participate in the Commonwealth Marine Reserves Review as member of the Temperate East Bioregional Advisory Panel. Bill was a partner (with the Community Environment Network CEN) in the establishment of the Central Coast Marine Discovery Centre at Terrigal in May 2009. He is also on the Editorial Board of the journal Aquatic Conservation: Marine and Freshwater Ecosystems.

A2.2.8 ASSOC. PROFESSOR MICHAEL ELLWOOD
Earth Environment Research School of Earth Sciences, Australian National University, A.C.T.

Associate Professor Michael Ellwood is a chemical oceanographer with an emphasis on the biogeochemical cycling of trace elements. He also has an interest in understanding metal and metalloid speciation in the ocean and the use of trace elements within marine organisms to reconstruct the chemistry of the ocean over millennia. A/Professor Ellwood joined the Research School of Earth Sciences, Australian National University in 2006. He is the convenor for the ANU Marine Science major and the minor, which is a multidisciplinary science education programme that transcends the ANU College of Physical and Mathematical Sciences and ANU College of Medicine Biology and Environment. In addition, he also convenes and teaches the third year course Marine Biogeochemistry (EMSC3023). This course explores the relationships between marine chemistry, marine biological and geochemical processes. Prior to his appointment he was a Research Scientist at the National Institute of Water & Atmospheric Research in New Zealand (2004-2006), a New Zealand Science and Technology Post-doctoral Fellow (2001-2004), Research Fellow at the University of Canberra (2000-2001) and a Post-doctoral Fellow at the University of Liverpool (Oceanography) 1998-1999. A/Professor Ellwood obtained his PhD from the University of Otago, New Zealand (1993-1998).

A2.2.8 DR SEBASTIAN HOLMES
School of Science & Health, University of Western Sydney, N.S.W.

Dr Sebastian Holmes is a benthic ecologist with expertise in the population genetics, trophic ecology and physiology of Australian, New Zealand and UK invertebrate sea floor communities. He joined the University of Western Sydney in 2011 as a Lecturer in Biological Sciences after two years at The University of Sydney. Prior to that, Dr Holmes worked as a Lecturer in Marine Ecology at the University of Liverpool (Port Erin Marine Laboratories), held a five year postdoctoral fellowship at the Netherlands Institute for Sea Research (NIOZ) and gained his Ph.D. in 1998 from the University of Sunderland. He currently lectures in Animal Physiology and Invertebrate Biology and has supervised numerous Masters, Honours and Ph.D. students. He has over fifteen years of sea-going research experience, both as a participant and as a cruise leader, from the shallow shelf sea of the UK, the Netherlands and Sweden to the deep sea of Australia and New Zealand. Since arriving in Australia in 2009, he has been very fortunate in being awarded five Next Wave cruises by the Marine National Facility, taking over forty Australian students on research cruises in Bass Strait and the Southern Bight.
APPENDIX 3

APPENDIX 3 – SUPPORT LETTERS

A3.1 MR TIM MOLTMANN
Director of the Integrated Marine Observing System, Tasmania.

A3.2 DR PAUHLA MCGRANE
Director of SMART, Galway-Mayo Institute of Technology, Ireland.

A3.3 MR AODHÁN FITZGERALD
Research Vessel Programme Coordinator and Operation Manager, Marine Institute, Ireland.

A3.4 DR CHRIS PIGRAM
Chief Executive Officer, Geoscience Australia, ACT.

A3.5 DR GWEN FENTON
Executive Manager Science Branch, Australian Antarctic Division, Tasmania.

A3.6 PROFESSOR SHERMAN YOUNG
Pro-Vice Chancellor of Learning, Teaching and Diversity, Macquarie University, NSW.