

4th May, 2011

Ms Clare McLaughlin
Acting General Manager
Research Infrastructure and Science Policy Branch
Science and Infrastructure Division
Department of Innovation, Industry, Science and Research

Dear Clare,

Thank you for the opportunity to comment on the *Strategic Roadmap for Australian Research Infrastructure* Discussion Paper. These comments from the IMOS Office (based at the University of Tasmania) are provided on behalf of the broader marine and climate science community. A list of IMOS Operators and Co-investors is included as an attachment, to give an indication of the breadth of this community.

General Comments and Introduction

At the outset, the importance of continuing to develop a Strategic Roadmap for Australian Research Infrastructure, and a related investment framework, must be reinforced.

This is a very enlightened approach to long-term, research infrastructure planning. Setting a small number of national priorities, funding them at scale (rather than spreading investment around in small amounts), and supporting the facilitation and leadership required to bring science communities together, is enabling an unprecedented level of national collaboration to be achieved within Australia. And by investing in the full cost of delivering data that can actually be taken up and used by the science community, the traditional 'bricks and mortar' view of research infrastructure is being transcended to create a new data-access paradigm that is recognised internationally as a world-leading approach. Australia would be wise to continue building on these strengths.

The Introduction raises a number of important issues that warrant comment.

1. *Page 4 - The 2011 Roadmap will aim to consider new or emerging areas of research which may require different types of infrastructure in the future, and determine whether the current mix of Capability areas continues to meet researchers' needs.*

It is worth noting that the existing Capabilities are still quite new in the context of research infrastructure investment timeframes, and that the benefits have only begun

to be realised. The potential for existing Capabilities to evolve in order to meet new and emerging needs should also be considered. A significant investment has now been made in both the physical infrastructure, and the capacity to create and develop national-scale, collaborative research capability. Future Roadmaps will need to place increasing emphasis on maximising returns from investments made.

2. *Page 4 - The 2011 Roadmap will consider priorities in an international context, reflecting the international, collaborative nature of modern research and the important role of collaborative research infrastructure in bringing researchers together.*

The emphasis here is on bringing researchers together. In Australia, it is also important to acknowledge that our share of new knowledge and innovation each year is approximately 2%, and that research infrastructure investment can play a role in helping us gain access to the other 98%. This point was well made in the 2008 review of the National Innovation System¹.

3. *Page 5 - The 2011 Roadmap is primarily concerned with medium to large-scale research infrastructure. However, any landmark infrastructure (typically involving an investment in excess of \$100 million over five years from the Australian Government) requirements identified in this process will be noted.*

Under the Marine and Climate Super Science Initiative, \$149.6M was committed to constructing a new bluewater research vessel to replace the aging *RV Southern Surveyor*. This included \$120M for capital and \$29.6 million over four years to increase the number of days at sea and to operate the replacement vessel once it is commissioned. There is currently no commitment beyond 2012-13 to provide additional funds required to operate the new vessel for the maximum number of days at sea, which will be imperative if the benefits of substantial new investment are to be fully realised. Bluewater research vessels are Landmark Infrastructure investments, and the requirement for additional operating funds needs to be seen in this context. Looking forward over five to ten years, it should also be noted that a single bluewater research vessel operating full time is the bare minimum for Australia given the size and significance of our ocean territory. It is plausible that the case could be made for a second vessel over this timeframe.

4. *Page 9 – Integration of Existing and Future Facilities: Several Expert Working Groups have discussed whether the next stage in national, collaborative research infrastructure should be to build on the existing funded projects not only in extending the infrastructure they provide, but also in integrating currently separate facilities to form a broader, coherent capability or set of services...In part, it arises from a desire to bring together elements of existing capabilities...It is also motivated by a desire to simplify some of the governance and access arrangements that have built up around NCRIS and Super Science as the programs have been implemented.*

¹ Venturous Australia, p20 <http://www.innovation.gov.au/Innovation/Policy/Documents/NISReport.pdf>

Integration is a complex issue with many dimensions. From an IMOS perspective, we would note that marine and ocean climate science is highly multi-disciplinary, and that we have significant integration challenges within our domain e.g. from open-ocean to coastal, and from physical to ecological. However this domain still represents only one slice through the whole Earth system, and we must not lose sight of the fact that marine and ocean climate science fits into a much bigger picture. The Australian Academy of Science recently released ‘*An Australian Plan to Develop a Science of the Whole Earth System*’², though this thinking is at a very early stage. A science of the Earth system presents huge global challenges, which won’t be met without access to continuous data streams of critical information about processes that operate on long time scales. For now, it would seem sensible to build coherent, multi-disciplinary, research infrastructure Capabilities with ‘open interfaces’ and ‘porous boundaries’, so as to maximise the potential for increasingly complex systems-based research to evolve as Australian scientists and their international collaborators develop the ability to address these challenges, and as governments, industries and communities develop the ability to apply more sophisticated scientific knowledge. The specific issue of integration within the coastal zone is further discussed under 1.C.1 below.

5. One important issue not specifically addressed in the Introduction is co-investment. It is only briefly mentioned under Pricing/Access (Page 8). There is a significant level of co-investment in the current Capabilities, by institutional partners, other Australian Government programs, State Governments, industry, and international collaborators. It would be helpful for the Roadmap to acknowledge this, and to provide some high level guidance about future expectations.

Environmentally Sustainable Australia (ESA)

This section of the Discussion Paper is most relevant to IMOS. Responses to each of the questions posed are as follows:

1.A.1 What are your views on the key future research directions identified and are there other key areas that have not been included?

In our view, the Expert Working Group has done an excellent job in identifying key future research directions.

- The Super Science Initiative is not specifically referenced in the ESA section, which is at odds with other sections. Including this as a driver, especially the Marine and Climate priority, would add considerable weight.
- The national frameworks listed at the top of Page 12 are highly-relevant. Biodiversity³ and Fisheries and Aquaculture⁴ would be valuable additions.

² <http://www.science.org.au/natcoms/nc-ess/documents/ess-report2010.pdf>

³ <http://www.environment.gov.au/biodiversity/strategy/index.html>

⁴ http://www.daff.gov.au/_data/assets/pdf_file/0016/1623211/fish.pdf

1.B.1 What are your views on the research infrastructure Capability areas identified, including their relative priority and their ability to support the current and future research needs?

In general, we support the research infrastructure Capability areas identified by the Expert Working Group. Points to note are as follows:

- The emphasis on long-term and standardised observations of the environment is strongly supported. This has emerged as the dominant focus in IMOS, and is proving to be very effective in driving multi-disciplinary collaboration at regional, national and international scales.
- Increased emphasis on integration across domains through adoption of a common approach to data discoverability, accessibility and interoperability is supported. The IMOS experience is that this is both a technical and cultural challenge. The technical component is complex but surmountable, through collaboration within and between Capabilities, underpinning support from e-Research in areas that are neither generic nor domain specific, and partnership with initiatives such as the National Plan for Environmental Information (NPEI) that will provide demand for integrated data streams. The cultural challenge will require whole-of Government support, beyond just research infrastructure, beyond innovation science and research, and across State and Territory Governments, industry and community. Within the marine and ocean climate domain, we are using the IMOS information infrastructure to create a much broader Australian Ocean Data Network (AODN) to address this challenge. The opportunity is large, but it will require sustained effort, adequate and ongoing resourcing of an integrating 'hub', and a broadly-based commitment to open access, particularly for publicly-funded data.
- The call for closer relationships between observation and modelling communities is supported, both at the national and international level. In IMOS we have found that this can emerge quite naturally in some cases (e.g. global climate modelling, national ocean forecasting), but requires much greater effort in others (e.g. biogeochemical modelling, ecosystem modelling). In part this is because we are supporting national-scale, multidisciplinary collaboration in the observations without a corresponding mechanism for the modelling. To some extent the research infrastructure Capabilities can catalyse these discussions. However it may also be necessary to put in place additional mechanisms e.g. 'virtual laboratories' supported through the e-Research domain.
- The need for continuing development of remote sensing capabilities is supported. Australia is not launching its own satellites, so it is imperative that we use our in-situ observing systems as a means to partner with current and future international activities. National collaboration is improving but more could be done, and this area may warrant specific attention in the Roadmap rather than being dealt with at the Priority or Capability level.
- The need to investigate a stronger contribution of the 'omics capabilities in understanding and tracking biodiversity is supported. This is particularly important for marine biodiversity as so much remains unknown. From an international perspective, Australia should remain engaged with developments coming out of the global Census of Marine Life.

1.C.1 What are your views on the existing funded facilities, including their ability to meet the current and future research needs?

As an existing funded facility, IMOS will confine its comments on this question to issues specifically related to integrated marine observing. Points to note are as follows:

- The Expert Working Group has correctly identified areas in which ocean observation needs to be extended i.e. the deep ocean, the under sea-ice environment, the Antarctic cryosphere and the oceanic regions surrounding Australia (tropical Indian, South East Asian, Southern, South West Pacific). Research infrastructure in these areas will support a strong science program that addresses priorities identified in the National Framework for Climate Change Science. It will also support priorities in climate variability and weather extremes, climate adaptation, offshore resource development, maritime safety, defence, marine biodiversity, and fisheries.
- The view that combined investments by existing Capabilities (including IMOS) are inadequate for the scale of the coastal zone research and management/policy challenges is noted. IMOS has certainly identified a number of gaps that could be addressed. However the coastal zone is a shared space requiring cooperation between marine, terrestrial, freshwater, geological, and atmospheric research communities. In recognition of this, IMOS, TERN, ALA and AuSCOPE have worked together to provide a joint response to the coastal aspects of the Discussion Paper under separate cover. There are five key points that the IMOS community would like to make based on our experience to date:
 1. The Roadmap is intended to articulate national priority areas, and it will be important to retain this national focus when scaling up in the coastal zone. The risk of localised fragmentation will need to be managed.
 2. The Roadmap is intended to inform future decisions about research infrastructure investment, and it will be important to ensure the focus remains on research infrastructure needs in coastal zone research. The risk of diverting scarce research infrastructure investment towards meeting other needs in the coastal zone must be managed.
 3. While the national research infrastructure Capabilities have much to offer in the coastal zone, there are many other important elements to consider e.g. the water management information system of the Bureau of Meteorology. It will be important for the role of research infrastructure Capabilities to be carefully shaped within the larger context of coastal zone research, information, policy and management.
 4. Discoverability, accessibility and interoperability of coastal zone data is not currently well-advanced in Australia. Arguably the most important contribution the research infrastructure Capabilities could make in the short to medium term would be to improve this situation through application of their information infrastructure and expertise. Visibility of existing information would enable more compelling articulation of knowledge gaps in the coastal zone.
 5. A closer relationship between observation and modelling communities is particularly important in the coastal zone, as a mechanism to drive integration and a means to bring science and management more closely together.

1.D.1 What are your views on the eResearch infrastructure identified, including their relative priority and ability to support the current and future eResearch infrastructure needs?

In general, we support the e-Research infrastructure priorities identified by the Expert Working Group. Points to note are as follows:

- In addition to the projects mentioned on Page 16, the collaboration tools being developed by the National eResearch Collaboration and Tools and Resources (NeCTAR) Project should also be noted.
- Another e-Research project, the Australian Research Collaboration Service (ARCS), is ceasing operation on 30th June 2011. IMOS has been using the ARCS data fabric for storage of its data, and we do not yet have certainty about future provision of these services. If Capabilities are to rely on e-Research services, it will be important for those services to be sustained long-term.
- All research infrastructure Capabilities will be making some level of 'e-Research' investment in order to achieve their outcomes. It is therefore important that the e-Research capability of the entire national program is not seen to be limited to the 'Platforms for Collaboration' area. In many instances, the relative roles are quite clear. IMOS will not be setting up its own NCI, and ANDS will not be liaising with the international marine and ocean climate data community on domain-specific standards and protocols. However the Roadmap could provide greater clarity about how investments are positioned in the future. For example, to what extent should ANDS be supporting activities within and across Capabilities, and to what extent should it be working outside of the research infrastructure Capabilities to establish an open access paradigm in the broader National Innovation System?

1.E.1 What are your views on the cross-disciplinary requirements identified, including their relative priority and ability to support the current and future research needs?

In general, we support the cross-disciplinary requirements identified by the Expert Working Group. Points to note are as follows:

- The need for continuing development of remote sensing capabilities is supported, as noted under 1.B.1.
- Stronger linkages to the BioPlatforms capabilities are particularly important for IMOS in the challenging area of sustained ecological observing.
- Greater opportunities to link bio-physical data streams with enhanced capability in the social sciences and humanities would be welcomed by the IMOS community.

1.F.1 Are there other programs/issues/developments not listed that you consider could be a driver for future research infrastructure investments or may impact on such investments?

The current developments identified by the Expert Working Group are noted, with comments as follows:

- The need to provide better pathways from the science to support good policy, efficient decision making and effective management is essential, but it is not something the

national research infrastructure program can achieve alone. It is perhaps even more important that the programs funding the research that will use the infrastructure are aligned with policy and management needs. This issue must be addressed holistically within the National Innovation System in order to achieve the end game. IMOS has found it necessary to develop a comprehensive engagement strategy across the marine and climate domain.

- The National Plan for Environmental Information and National Framework for Climate Change Science are identified as important drivers for continued investment. As noted under 1.A.1 and 1.C.1, current and developing frameworks in climate variability and weather extremes, climate adaptation, offshore resource development, maritime safety, defence, marine biodiversity, and fisheries and aquaculture will also be important drivers for broadly-based research infrastructure Capabilities such as IMOS.
- The emphasis on international partnership is strongly supported. By making strategic investments in globally significant research infrastructure, Australia attracts strong international collaboration on issues of national significance, and positions Australian science to be world class. From an IMOS perspective, our location in the southern hemisphere provides Australian marine and climate science with a natural advantage that can be exploited.

Other National Research Priorities

Many capabilities will underpin research across more than one National Research Priority. IMOS has the potential to support research in the following areas of relevance to other priorities:

- Sustainable fisheries and aquaculture
- Marine biodiversity/bio-discovery
- Sensorisation, computation and simulation
- Maritime safety and defence
- Marine hazards
- Marine spatial planning
- Offshore resource development, and
- Renewable ocean energy.

e-Research Infrastructure

A number of comments relevant to this section have been made in previous sections. The main point to reinforce is that the Roadmap should reflect not just the underpinning nature of the projects covered in this section, but the pervasiveness of e-Research across the entire national research infrastructure program. Specific comments are as follows:

- 6.A.1-4: The trends are well-articulated.
- 6.B.1: The comment about data management on Page 57 sounds unconvincing. The comment about collaborative tools and resources is supported, through we would like to be able to realise some of this potential in the near future.

- 6.C.1-2: These comments are supported.
- 6.D.1-2: To a large extent, the comments in this section apply to the national research infrastructure program as a whole, rather than e-Research in particular.

Please do not hesitate to contact me if you wish to discuss further. We are happy to have these comments made public.

Yours sincerely,

A handwritten signature in black ink that reads "Tim Moltmann". The signature is written in a cursive style with a long horizontal flourish extending to the right.

**Tim Moltmann - IMOS Director, University of Tasmania
on behalf of the broader IMOS community**

ATTACHMENT 1 – List of IMOS Operating Institutions and Co-Investors

Operators

1. Australian Institute of Marine Science
2. Bureau of Meteorology
3. Commonwealth Scientific and Industrial Research Organisation
4. Curtin University
5. Geoscience Australia
6. James Cook University
7. South Australian Research and Development Institute/Flinders University
8. Sydney Institute of Marine Science, a collaboration between University of New South Wales, University of Sydney, Macquarie University and University of Technology Sydney
9. University of Tasmania
10. University of Western Australia

Co-investors

- Antarctic Climate and Ecosystems Collaborative Research Centre
- Australian Antarctic Division
- Australian Climate Change Science Programme
- Australian Ocean Data Centre Joint Facility
- Australian Research Collaboration Service
- Department of Economic Development, Tourism and the Arts (Tas)
- Department of Environment, Climate Change and Water (NSW)
- Department of Fisheries (WA)
- Department of Primary Industries (NSW)
- Department of Primary Industries (Vic)
- Department of State Development, Trade and Innovation (Qld)
- Flinders University
- (ARC Research Network on) Intelligent Sensors, Sensor Networks and Information Processing Network
- Interactive Virtual Environments Centre
- Macquarie University
- Manly Hydraulics Laboratories
- Marine National Facility
- Monash University
- Myriax
- Ocean Tracking Network (Canada)
- Queensland Cyber-Infrastructure Foundation
- Queensland Government
- Royal Australian Navy (Directorate of Oceanography and Meteorology)
- Scripps Institute of Oceanography (USA)
- Sea Mammal Research Unit (UK)
- Sydney Water

- Tasmanian Aquaculture and Fisheries Institute
- Tasmanian Partnership for Advanced Computing
- Tropical Marine Network
- University of New South Wales
- University of Sydney
- Vemco