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By email: RoadmapSubmissions@education.gov.au

2016 National Research Infrastructure Capability Issues Paper – AIMS Response

Dear Dr Finkel

Thank you for the opportunity to provide a submission on the National Research Infrastructure Capability Issues Paper (Issues Paper) for the 2016 Research Infrastructure Roadmap (2016 Roadmap).

In addition to this submission, AIMS is also part of and endorsing the submissions made by:

- Publicly Funded Research Agencies Joint Submission
- National Marine Science Committee
- National Marine Science Committee – Research Vessel Alliance
- Integrated Marine Observing System Advisory Board

If you have any questions please contact Mr David Mead or Mr John Gunn.

Yours sincerely

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Referenced Documents

Securing the future of Australia's National Research Infrastructure Portfolio - Aligning National Investment in Research Infrastructure with National Benefit (PFRA 2015 Discussion Paper)

National Marine Science Plan 2015-2025 Driving the development of Australia's blue economy (NMSC Decadal Plan)

National Research Infrastructure Capability Issues Paper (NSMC Roadmap Issues Paper Response)

PFRA Submission to the National Research Infrastructure Capability Issues Paper (PFRA Roadmap Issues Paper Response)

Other Comments

A. Process

The Roadmapping seeks to set ten year investment priorities for medium to large scale NRI within the current and emerging Australian context. This could potentially involve budgets of hundreds of millions of dollars per annum. If the outcome is to be trusted and serve as an effective investment guide, there needs to be transparency of thinking and structure to the arguments and recommendations being made. It is reasonable to expect that each thematic assessment would include consideration of factors such as:

a) The current and emerging research context and priorities (including Science and Research Priorities), and how Australia should be positioning itself. This should be supported by documented, specific strategic plans for elements of the SRP. Relevant science communities (not individuals or single entities) should be required to present strong cases for why particular research infrastructure is required, forecast its use (and perhaps how others might co-invest), and (importantly) identify the likely impact and time to impact.

b) Existing research infrastructure, its capability, utilisation, performance and impact, and gaps compared with future priorities, as discussed above.

c) Options as to how gaps might be addressed, including accessing international capability.

d) Application of an agreed method to value and prioritise across thematic areas and options

These then drive to a set of logical (and defendable) conclusions regarding future requirements covering retention of existing capability, closures, and options for new capability development and their associated priorities should funding become available.

We highlight the 2015 National Marine Science Plan as a good example of these principles being applied to a thematic area, and recommend that this be utilised as a case study when preparing the Roadmap.

B. Research Community Engagement

AIMS recommends that as far as possible the Roadmap be based on science community recommendations and not based on individuals or institutional based ideas.

For example, during 2014/2015, the marine science community undertook a comprehensive assessment to document current and future marine science challenges and how these could be responded to, culminating in the development of the "2015 National Marine Science Plan". This included an assessment of current and future research infrastructure priorities and extensive consultation with stakeholders in Australia's marine science capability.

Noting the current process and stage of development, we recommend that the first draft Roadmap be tested against any existing recent thematic and/or community based plans prior to release. Subsequent feedback preference should then be given to whole of research community submissions (or other clusters of relevant joint submissions) rather than individual organisational perspectives.

C. National Benefit and Prioritisation

It is recommended that the committee develop criteria for how National Benefit is to be expressed. This then allows a transparent prioritisation methodology to be developed and applied to the identified opportunities and risks.

It is recommended that an "overall value" approach be adopted that seeks to identify the broader value streams associated with each option and not be limited to an alignment test with current national research priorities. Some of the dimensions that might be included in an overall value based assessment model include:

1. Social, environmental and economic benefit streams;
2. Progression of national science and research priorities;
3. Alignment to and progression of Australia's innovation framework;
4. Progression of key policy agendas (for example Northern Australia Development);
5. Incremental investment and clustering synergies and benefits;
6. Capability decentralisation and adjacency to issues and opportunities.

In parallel it is recommended that separate consideration be given to macro dimensions not easily addressed when assessing individual investment opportunities. Examples include:

- Relative priority given to opportunity realisation infrastructure (for example, infrastructure to foster innovation and subsequent economic growth) versus risk mitigation infrastructure (for example, biosecurity);
- Relative priorities across thematic areas and broader perspectives as to Australia's global positioning;
- Relative merits and priorities to invest in new landmark scale NRI versus small to medium scale NRI. Australia can support only a limited portfolio of landmark NRI, and an order of magnitude more medium and small scale NRI. These are such contrasting investment options, that relying on a project based investment prioritisation process in isolation is unlikely to deliver optimal decisions.

The principles and benchmarks established would not be “hard” investment rules, however they do provide a mechanism to review and test future investment scenarios.

D. NRI Review Scope

In order to be able to better consider what national research infrastructure (NRI) will be included in the 2016 Roadmap, consideration should be given to a definition which encompasses not just equipment, but also the people and the techniques which underpin the NRI.

The PFRAs have adopted a typology for NRI, consisting of three core categories: Landmark Infrastructure, National Facilities and Major Institutional Infrastructure. The key distinction of relevance between these three categories is the degree of genuinely national, collaborative management and use versus institutional focus (i.e. facilities may be owned and operated on behalf of the research community or exclusively to support the mission and priorities of the institution). A further distinction is made on the basis of scale – a small number of research infrastructure assets are of such a scale and complexity and represent such a fundamental and ongoing need that they need to be funded, managed and governed as a separate category (i.e. ‘Landmark’), independent of their national or institutional focus. It should be further noted that for major institutional infrastructure operated by the PFRAs, even though this is institutional or mission focused, the PFRAs have a mandated national benefit focus.

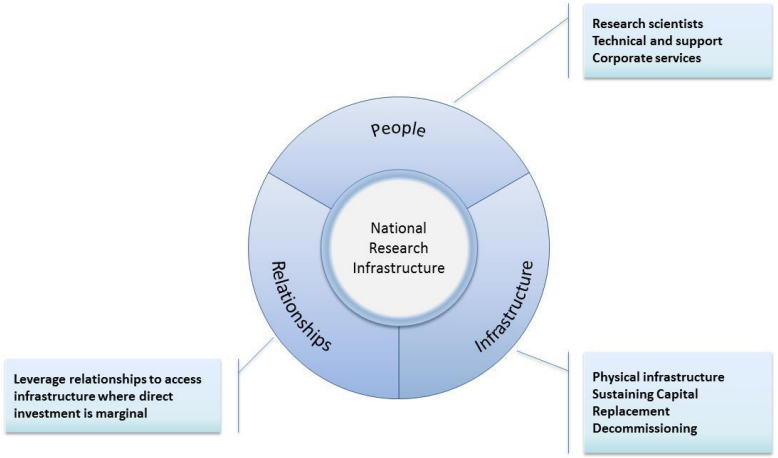
Title	Characteristics	Examples
Landmark	Multi-country, multi-user, multi-institutional partners, multidisciplinary or mission focussed Unique, very large-scale, complex facilities which are international in capacity and used to support research undertaken to address international and national strategies and priorities Funding arrangements developed on a case by case basis Budgeted within host's core budget Capital cost: $100m and above	ASKAP (a global example of the Square Kilometre Array) Australian Animal Health Laboratory Australian Synchrotron OPAL research reactor RV *Investigator* Super Computer Infrastructure Atlas of Living Australia collections*
National Facilities	Multi-user, multi-institutional partners, multidisciplinary or mission focussed Unique, large-scale, complex facilities which are used to support research undertaken to address national and regional strategies and priorities Hosted by an organisation(s) on behalf of the research community which accesses and utilises the facility Budgeted separately from hosts core budget Priority established by broader research community Capital cost: $10M - $100m	AARNet Integrated Marine Observing System National Deuteration Facility Nanofabrication Facilities National Imaging Facility National Sea Simulator Other NCRIS facilities
Major Institutional	Predominantly for institutional research goals, aligned with national research priorities Research focus set by institution, with a strategic purpose ranging from specific research sectors or locations to broader national strategies and priorities Budgeted as part of institutional budget Institutional governance Capital cost: $10 million - $50 million	Coastal Research Vessels General Laboratories Industry funded facilities Specialled industry sector specific laboratories

AIMS recommends that the Roadmap directly cover the National Facility and Landmark Infrastructure categories. In addition, that it also consider major institutional infrastructure where this infrastructure has a national focus but for appropriate reasons its usage is solely by the institution; an example being costal research vessels that in aggregate provide a national capability, but are owned and operated by institutions and operate on a developing alliance model.

Nomenclature

In order to ensure clarity, clear and agreed infrastructure naming protocols need to be developed. AIMS recommends that the categorisations developed by the PFRAs be adopted (Landmark, National Facilities, and Major Institutional), and at the same time consideration needs to be given to renaming the NCRIS program. NCRIS is an extremely valuable funding program that needs to be retained, however it only funds a subset of infrastructure that is "national and collaborative", key features of the NCRIS name. Unfortunately at times NCIRS is inadvertently considered to "be" the NRI, creating misconceptions and issues.

Question	AIMS Response
National research Infrastructure Policy Issues	
1. Are there other capability areas that should be considered?	The capability areas are broadly defined and additional areas are not required. However marine science capability is narrowly confined to Environment and Natural Resource Management. Marine science is also key to driving the development of Australia's blue economy, which is currently valued at more than $47 billion per annum and expected to more than double over the next decade. This includes important national science and research priorities in Food Security, Energy Security and Resources Security. The socio-economic benefits of excellent, impactful and innovative marine science are undersold in the Issues Paper, and it will be important to address this in the Roadmap as it must respond to the National Innovation and Science Agenda.
2. Are these governance characteristics appropriate and are there other factors that should be considered for optimal governance for national research infrastructure?	AIMS supports the current Roadmapping initiative, however we recommend that consideration is given to adopting a mechanism that facilitates ongoing development and refinement of Australia's NRI. The short timeframe of the current process dictates a high level approach in order to cover the full breadth of NRI. A more continuous process would enable the necessary refinement and adaptation to current risks and opportunities. This would occur on an ongoing cyclical basis, and would replace the current unpredictability of episodic reviews, while at the same time allow deeper assessment, performance review and planning. Consideration should be given to incorporating a governance mechanism that enables research infrastructure to "transfer out" of the NCRIS funding program should that be appropriate. The NCRIS program seeks to fund a broad infrastructure portfolio within a limited funding envelope. This caps the size of any one facility, whereas from a whole of NRI perspective there may be a business case to grow a facility beyond this cap. A mechanism that allows growth options for current NCRIS facilities to be prioritised alongside existing and potential national and landmark facilities would alleviate this risk.

Question	AIMS Response
3. Should national infrastructure investment assist with access to international facilities?	There are many scenarios where international access is beneficial including: • Accessing large infrastructure that we will never be built in Australia • Where the technology underpinning the NRI is rapidly developing, or there is a high risk of disruptive technology emerging • Where there are research collaboration benefits • When installing kit on major international facilities, such that we then gain access • Where there are cost benefits and no other compelling reasons to develop locally In Roadmapping Australia's NRI, the human resources that support the physical infrastructure and relationships that allow two-way access to infrastructure must be considered (as outlined in the following figure). Australia needs well-funded research infrastructure aligned with priority areas, which is supported by skilled people to both operate and derive the research benefits from the infrastructure. However, for various reasons, there will be times when the best outcome for Australia is to partner with international institutes and universities to access required infrastructure.  Where partnering displaces the need to develop research infrastructure within Australia, and the cost-offsets should be utilised to fund an access program. It is recommended that a single larger access program is established with a broad funding mandate to allow flexibility.

Question	AIMS Response
4. What are the conditions or scenarios where access to international facilities should be prioritised over developing national facilities?	Refer answer to Question 3
5. Should research workforce skills be considered a research infrastructure issue?	This is an important area, particularly with respect to: • workforce requirements to develop and operate NRI (technicians, engineers, specialist trades). • development of young scientists in new and emerging research infrastructure capability, how it can benefit and integrate into their science. Consideration of the workforce required to operate research infrastructure, as well as the researcher capability required to derive benefit from the investment in the infrastructure is critical to any discussion regarding NRI (refer to the figure presented in Question 3). Refer to the PFRA Roadmap Issues Paper Response for further recommendations in this area.
6. How can national research infrastructure assist in training and skills development?	No comments
7. What responsibility should research institutions have in supporting the development of infrastructure ready researchers and technical specialists?	It is critical that this occur if the value of research infrastructure is to be maximised. Currently there are many instances where this already occurs (for example AIMS currently funds internal staff development and the development of students, early career and research collaborators from its core budget). Broader development would require additional funding to be made available, perhaps by a competitive access funding program established for this purpose.

Question	AIMS Response
8. What principles should be applied for access to national research infrastructure, and are there situations when these should not apply?	As a generalisation "free at point of access" should be the goal for Australian researchers, however this requires that the operators be funded the full costs to operate, maintain and run experiments within the facility. Alternative models for access by Australian researchers to Australian research infrastructure are effectively "transfer pricing" with all of the associated overheads and other complexities. However, each facility is unique and the operator funding, access rules and access pricing should all be agreed at the point of developing the facility. Refer to the PFRA 2015 Discussion Paper for the proposed "agreed asset management plan concept" for further details. It should also be recognised that there are scenarios where charging is appropriate, for example: • Access for commercial purposes; • Where a pricing signal is required to optimise usage requests; • Long term co-investments by partners to guarantee access. The issues paper makes the statement that "broad accessibility enables greatest possible use/value to government" and while this is often true, it is not exclusively true. Governance and access arrangements need to be flexible and optimised to each circumstance, with funding allocated to highest priority needs (value creation areas) and not allocated based on favouring one governance model over the other. For example, at times it might be highly appropriate to build infrastructure dedicated to a specific use or set of users, some examples being: • Where high degree of usage flexibility is required by an entity in order to service high priority needs and where for example "pre booking in advance" is not feasible, and therefore the opportunity is lost; and • Where individual users have high priority needs that saturate the usage of the infrastructure (or multiples of the infrastructure). Where broad access is appropriate, then we recommend that the definition of "merit based" be both defined and broadened compared to its conventional definition. The joint PFRA Roadmap Issues Paper Response on this concept and provides specific examples of broader merit assessment criteria.

Question	AIMS Response
9. What should the criteria and funding arrangements for defunding or decommissioning look like?	It is unclear as to what is meant by "defunding", noting that there are two valid definitions that need consideration: • Processes to assess, and if feasible or appropriate, transition the funding of research infrastructure from government to other sources (e.g. self-funding); and • Processes to assess and determine to no longer retain an existing government funded infrastructure capability. This then needs to factor decommissioning costs, contractual obligations, IP etc. In both circumstances a transparent mechanism needs to be developed and utilised to review existing performance and determine ongoing funding priorities and options. It is recommended that at the point of investing in research infrastructure, a relevant review period should be set, where an independent group reviews performance and ongoing need. Refer to the 'agreed asset management plan" concept contained within the PFRA 2015 Discussion Paper.

Question	AIMS Response
10. What financing models should the Government consider to support investment in national research infrastructure?	The discussion document focuses exclusively on NCRIS when considering financing models. It needs to be recognised that while NCRIS is a critical component, it is only a small percentage of government funded NRI, and a discussion of financing models and issues needs to span the entire NRI portfolio. There is a need to transition off "depreciation expenses" being the method to determine capital funding requirements to sustain and replace infrastructure, but in the interim it must be retained until a workable alternative can be agreed. Additionally, the financing model must consider whole of life funding requirements (capital development, sustaining capital, operations and maintenance, incremental enhancements and decommissioning). Refer to the PFRA 2015 Discussion Paper and the PFRA Roadmap Issues Paper Response for more complete details on both of these areas. Options around using Public Private Partnerships to fund research infrastructure could be explored. There are a number of highly successful PPPs operating in technology areas globally. It would be worthwhile assessing if the principles that have made these successful will translate to research infrastructure. These include: • Allowing (facilitating) for the development of unregulated revenue streams within the PPP. For a PPP to exist there needs to be value returned to each partner, which in the case of NRI would be utilising the NRI for their individual gain. Unregulated revenue refers to where the PPP as a combined entity works to develop additional new commercial opportunities recouping the partner investment costs; and • Partnering with specialist equipment manufacturers (typically leasing as opposed to purchasing), such that equipment is developed/replaced as technology progresses.
11. When should capabilities be expected to address standard and accreditation requirements?	When this is required by legislation/regulation or when the research requires this. We do not see a case for "special exceptions" from requirements with which we expect others to comply.
Capability Focus Areas	

Question	AIMS Response
12. Are there international or global models that represent best practice for national research infrastructure that could be considered?	No comment
13. In considering whole of life investment including decommissioning or defunding for national research infrastructure are there examples either domestic or international that should be examined?	It is recommended that industry based physical asset management models are assessed. Australia's Research Infrastructure portfolio is not particularly large, complex or unique (from an asset management perspective) and is comparable to smaller tier one manufacturing/processing/energy companies. These sectors have developed extensive asset management expertise (from planning to development to operations to disposal) and their models could be directly applied.
14. Are there alternative financing options, including international models, that the Government could consider to support investment in national research infrastructure?	See comments on question 10.
Health and Medical Science	

Question	AIMS Response
15. Are the identified emerging directions and research infrastructure capabilities for Health and Medical Services right? Are there any missing or additional needed?	No comments
16. Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?	No comments
17. Is there anything else that needs to be included or considered in the 2016 Roadmap for the Health and Medical Sciences capability area?	No comments
Environment and Natural resources Management	

Question	AIMS Response
18. Are the identified emerging directions and research infrastructure capabilities for Environment and Natural Resource Management right? Are there any missing or additional needed?	The emerging directions and research infrastructure capabilities for Environment and Natural Resource Management are narrow, terrestrial in focus and without sufficient evidence to support them representing the priorities of the research community and their stakeholders. It fails to mention Australia's 10.2 million square kilometres of ocean territory (larger than its 7.7 million square kilometre terrestrial land area), which contributes more than $47 billion to the Australian economy each year and is projected to be in the order of $100 billion per annum in 2025 (Australian Institute of Marine Science Index of Marine Industry). *Sub-section comments* Section 6.1.1 states that "Recent advances will see future efforts shifting from how to collect and manage data to how to support data integration, modelling and analysis to improve prediction and reduce uncertainty." This may be true in some domains, but is not so true in marine science. In marine biogeochemical and ecosystem modelling we have very sophisticated approaches to "data integration, modelling and analysis", but in fact lack the data to reduce uncertainty. Therefore, data collection is expected to be an ongoing need for the foreseeable future. Section 6.1.2 splits the discussion of challenges into southern and northern halves of the country which runs counter to statements elsewhere that recommend a national integrated approach be adopted. We support this integrated approach and one need only look at tropical cyclones to explain why. Rainfall from tropical cyclones can feed major rivers such as the Darling, which ultimately impacts on southern Australia and the coastline around the mouth of the Murray-Darling River. The lack of profile for our marine territory highlighted above also results in this section ignoring Australia's significant challenges in its tropical marine environment. Australia's tropical reefs, including the Great Barrier Reef (GBR), all of which make significant contributions to our blue economy, face significant threats from climate change (risks include ocean warming, ocean acidification, intensification of storm events and changes to the drought-flood cycle) and other pressures (such as predation by crown-of-thorns starfish and excess nutrients, fine sediments and pesticides) and are collocated with rich natural gas deposits in north-West Australia and subject to development pressures. AIMS strongly recommends a more holistic view of national challenges. AIMS supports the NMSC's Decadal Plan and the seven identified grand marine challenges: marine sovereignty, security and safety; energy security; food security; biodiversity, conservation and ecosystem health; urban coastal environments; climate variability and change; and research allocation. Only some of these are included in section 6.1.2 and AIMS believes they should all be included in the 2016 Roadmap. Likewise, sections 6.2.2 and 6.3 align with some, but not all aspects, of the NMSC's Decadal Plan and the associated recommendations for research infrastructure. In summary, these need to be broadened to include the following (refer to the NSMC submission for further details): • an adequately funded national research vessel fleet consisting of bluewater, polar and shelf-scale vessels which allow

Question	AIMS Response
19. Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?	AIMS would highlight the Global Ocean Observing System, in particular via the infrastructure investments detailed in the 2015 National Marine Science Plan (Ships of Opportunity, IMOS expansion, remote technologies). Infrastructure should include the soft components (i.e. models that the infrastructure produces) such as global models which Australia needs for local decision-making (e.g. global climate, oceanographic and meteorological models). These models often inform each other. For example, the Australian Community Climate and Earth-System Simulator (a major Bureau of Meteorology model) both consumes global data and model outputs and informs global models.
20. Is there anything else that needs to be included or considered in the 2016 Roadmap for the Environment and National Resource Management capability area?	No comment
Advanced Physics, Chemistry, Mathematics and materials	
21. Are the identified emerging directions and research infrastructure capabilities for Advanced Physics, Chemistry, Mathematics and Materials right? Are there any missing or additional needed?	No comment

Question	AIMS Response
22. Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?	No comment
23. Is there anything else that needs to be included or considered in the 2016 Roadmap for the Advanced Physics, Chemistry, Mathematics and Materials capability area?	No comment
Understanding Cultures and Communities	
24. Are the identified emerging directions and research infrastructure capabilities for Understanding Cultures and Communities right? Are there any missing or additional needed?	AIMS recommends that there should be a discussion on coastal communities (remote, regional and urban) and how these are forecast to be impacted as a result of factors such as increased development (for example the Northern Australia development agenda resulting in changed water usage and hence coastal ecology and indigenous livelihoods) or the changing climate (adverse weather, sea level increases). Likewise, there can be substantial impacts upon coastal infrastructure, which are critical economic drivers for coastal communities. Priorities from this analysis can inform the required research and hence underpin NRI gaps.

Question	AIMS Response
25. Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?	
26. Is there anything else that needs to be included or considered in the 2016 Roadmap for the Understanding Cultures and Communities capability area?	
National Security	

Question	AIMS Response
27. Are the identified emerging directions and research infrastructure capabilities for National Security right? Are there any missing or additional needed?	In addition to the water aspects covered under question 18, AIMS believes that marine sovereignty, security and safety as well as food, energy and resources security are important parts of national security and that these are missing from the capability issues paper. Our marine estate is a vital yet challenging contributor to Australia's sovereignty, national security and safety and is increasingly more important for our food, energy and resources security. Marine stakeholders, including the shipping industry, coastal managers, port operators, the offshore oil and gas industry, defence, border protection, the aquaculture and fishing industries, tourism, recreational boating, coastal engineers and emergency managers, all require accurate and up-to-date information about sea state, atmospheric conditions and geohazards, to support their multiple uses of the jurisdiction. There is a constant need for information at timescales that stretch from hours to weeks—whether it is for industry operations, or for prediction, prevention, mitigation or compliance activities, out at sea or along the coast. Meeting these needs is a constant challenge, but particularly so in the case of extreme weather events which remain poorly understood and a challenge to predict. Their impact is also disproportionately strong, and climate change is predicted to increase the intensity and frequency of some events. These extreme events include both physical and biological natural hazards such as destructive winds, waves and storm surges, tropical cyclones, flooding, surface and subsurface currents, temperature extremes, beach erosion, algal blooms, coral bleaching and invasive species. In order to address these challenges, we need to: • create a comprehensive national observing system, covering open ocean to coastal and littoral zones, and which includes in situ measurements, remote sensing and a national information infrastructure; • invest in state-of-the-art national computational infrastructure to develop short-to-medium range (days to weeks), uncoupled and coupled biophysical models for analyses and forecasts, from open ocean to coastal and littoral zones; and • use overseas experiences and expertise through collaboration wherever possible and appropriate.

Question	AIMS Response
28. Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?	
29. Is there anything else that needs to be included or considered in the 2016 Roadmap for the National Security capability area?	
Underpinning Research Infrastructure	
30. Are the identified emerging direction and research infrastructure capabilities for Underpinning Research Infrastructure right? Are there any missing or additional needed?	No comment

Question	AIMS Response
31. Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?	No comment
32. Is there anything else that needs to be included or considered in the 2016 Roadmap for the Underpinning Research Infrastructure capability area?	No comment
Data for Research and Discoverability	

Question	AIMS Response
33. Are the identified emerging directions and research infrastructure capabilities for Data for Research and Discoverability right? Are there any missing or additional needed?	The identified emerging directions are comprehensive, but AIMS believes that the following should also be considered: • The paper does not mention the impact that the Internet of Things (IoT) will have on national data holdings. The IoT will become commonplace over the coming years and generate an amount of data for which we are unprepared. While much of this will be in the consumer sector, this is an example of the continuing convergence between research and other sectors, where R&D in the research sector leads to innovation in other sectors, which in turn can produce valuable research data. The increasing analysis of social media to answer research questions is another example of this convergence. • The network infrastructure for movement of datasets throughout Australia is slowly improving in terms of speed and connections between major centres but services to regional centres, which is critical for marine science, significantly lags behind the rest of Australia and this will only worsen over the next decade. For a national approach to research infrastructure, investment in a truly national network is critical. Furthermore, while the national communications network is improving, attention must also be paid to its reliability, which remains under par by international standards with too many outages and slow service restoration. • Modelled data should be given the same profile as other forms of data. Many organisations, such as the Bureau of Meteorology, generate substantial data through models. In AIMS' case, we generate significant data holdings through oceanographic modelling and these models then forecast conditions at locations for which primary data cannot be generated. • Generating value from integrating datasets from different sectors depends on robust approaches to data interoperability and taxonomies. This will improve sharing of data across scientific domains and international boundaries. Marine science has the Ocean Data Interoperability Platform but a national and cross-sectoral approach will magnify the value able to be derived from Australia beyond what can be achieved by the measures highlighted in the paper.

Question	AIMS Response
34. Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?	There needs to be strong engagement with research infrastructure in the international private sector, some of which have capabilities larger than Australia has as a nation. For example, innovative data companies such as Google and Facebook have very large and capable data centres, data analysis initiatives and R&D groups. They also benefit from being in a single organisation working towards a common goal and not spread across multiple organisations with different drivers and directions. Consideration should be given as to how Australia can better leverage these capabilities.
35. Is there anything else that needs to be included or considered in the 2016 Roadmap for the Data for Research and Discoverability capability area?	There will be an increasing reliance on citizen science in the coming decades, which will require close engagement with the commercial ICT sector to ensure that the broader community can properly and cost-effectively, engage in research initiatives - e.g. network coverage and stability, mobile computing capability. Networks for domestic connectivity are highlighted, but we must not neglect the costs and feasibility of moving very large datasets nationally and internationally. Importation of very large and continually updated datasets such as remote sensing data from new satellites is hindered by low bandwidth and the cost of moving the data into Australia.