

## ATSE SUBMISSION TO THE 2016 NATIONAL RESEARCH INFRASTRUCTURE ROADMAP CAPABILITY ISSUES PAPER

<b>Name</b>	Dr Matt Wenham
<b>Title/role</b>	Executive Manager, Policy and Projects
<b>Organisation</b>	Australian Academy of Technology and Engineering (ATSE)

The Australian Academy of Technology and Engineering (**ATSE**)<sup>1</sup> welcomes the opportunity to provide input into the 2016 National Research Infrastructure Roadmap (**2016 Roadmap**) Capability Issues Paper (**Issues Paper**).

ATSE supports the collaborative approach taken to determining the priorities for national research infrastructure, and considers the method of drawing input from the expert working committee to be appropriate and focused. To facilitate additional input, ATSE has developed a submission to the Issues Paper drawing upon the expertise of ATSE Fellows. A survey was distributed to over 800 Fellows to access their areas of expertise, and an expert group was convened to assist with ATSE's direct response.

ATSE considers it important for the 2016 Roadmap to focus on:

- Alignment with national research priorities;
- Emphasising collaboration;
- Capabilities rather than disciplines; and
- Dealing with data.

Further, funded projects should be complementary, rather than supplementary, to existing research infrastructure programs with strategic consideration of investment by government:

- in those areas where it is necessary in the context of national priorities, under specific programs and in the national strategic interest;
- where it can enhance collaborative research and development opportunities by Australian researchers and commerce;

---

<sup>1</sup> ATSE advocates for a future in which technological sciences, engineering and innovation contribute significantly to Australia's social, economic and environmental wellbeing. The Academy is empowered in its mission by some 800 Fellows drawn from industry, academia, research institutes and government, who represent the brightest and the best in technological sciences and engineering in Australia. The Academy provides robust, independent and trusted evidence-based advice on technological issues of national importance. ATSE fosters national and international collaboration and encourages technology transfer for economic, social and environmental benefit.

- in areas where Australia is, or potentially could be, world-class in research and provides international leadership in research opportunities that would otherwise be too large or too complex for individual institutions to fund; and
- where there is a multi-disciplinary context and national/international relevance.

Essential to the success of these projects is the establishment of access arrangements for a range of stakeholders to each facility. Infrastructure must be accessible by all categories of researchers, including meritorious, commercial and international users, terms of access should be transparent, and the cost of access should not be prohibitive. Regular, programmed reviews of facilities will ensure ongoing relevance and efficient management of project infrastructure. Critically, ongoing funding for operational expenses must be factored in to ensure operational stability and to remove barriers to access.

Further, pivotal to the 2016 Roadmap and to the successful implementation of these principles is the positioning of data access, storage and management. Each research infrastructure area outlined in the Issues Paper has a relationship with data. The prioritisation of an effective data storage mechanism staffed by skilled and qualified data managers, who can support efficient services for that data, must be an integral part of the national infrastructure. Data storage, viewed from this perspective, belongs to the *Underpinning infrastructure class* (Chapter 10), integrated with networking and computation provisions. The other aspects of data outlined in Chapter 11 are appropriately positioned as “data management principles” elevated to an implementation policy.

ATSE recommends that the 2016 Roadmap be more strongly positioned within the national research and innovation policy framework. This would provide an additional guide for prioritising government investments given the inevitable underfunding climate ahead, and would assist in balancing “business as usual” with future needs.

The Academy has provided additional input to the specific questions in the Issues Paper below.

## Questions

### **Question 1: Are there other capability areas that should be considered?**

ATSE considers that the Issues Paper has been comprehensive in its inclusion of capability areas. Additional areas that could be considered include the capabilities required for research in:

- energy (both in relation to environment and natural resource management, and advanced physics, chemistry and materials)
- life sciences (which received only limited coverage in the issues paper)
- earth sciences.

### **Question 2: Are these governance characteristics appropriate and are there other factors that should be considered for optimal governance for national research infrastructure.**

ATSE supports the governance characteristics outlined in the Issues Paper and considers they provide a robust basis for ongoing discussions. Additional characteristics for

consideration could include, for example, a focus on the frameworks for accountability such as:

- an appropriate board structure and the importance of outstanding leadership at the Chief Executive and Director levels;
- adequate oversight of the investment;
- oversight of the operations of the facility;
- enhance collaboration
- an annual review of the strategic position, relevance and value of the facilities;
- an investment and operating plan for the five year funding period;
- an access and pricing plan;
- an annual report of activities; and
- an annual business plan for the following year.

Further, the governance model should be prescriptive, in line with those incorporated for the CRC Program, with preferential alignment with scoring used in industry for competitive infrastructure bids. Further principles could include:

- Advocating that stakeholders ('beneficiaries') make a financial commitment for operating costs;
- A defined career path for skilled technical operators, parallel to researchers; and
- Stakeholders should put in place procedures that their researchers preferentially use the facility over any other available in Australia or internationally.

**Question 3: Should national research infrastructure investment assist with access to international facilities?**

Yes, national research infrastructure investment should assist with access to international facilities, for it is unlikely that there is an important research topic that is uniquely Australian. This is particularly relevant, as research issues requiring access to state-of-the-art facilities are by their very nature global in scope.

Importantly however, investment in international facilities in the 2016 Roadmap should be in the context of international collaboration needs, commensurate with the objectives of the program, and foster opportunities for Australian research excellence in areas of national priority.

**Question 4: What are the conditions or scenarios where access to international facilities should be prioritised over developing national facilities?**

Funding access to international facilities should be prioritised over developing national facilities in instances only where it:

- provides access to leading edge research infrastructure on a lower cost basis than developing duplicative Australian facilities (not because it does not have priority allocated for Australian facilities that Australia cannot afford);
- improves the quality of Australian research;
- addresses research questions, for example, in astronomy or oceanography, which are truly international in scope;

- facilitates interaction across the international research and innovation system;
- enables new ways of conducting research;
- provides opportunities for new types of research; and
- attracts and retains high quality researchers.

Current examples include funding access to CERN or engaging in partnerships to progress the Square Kilometre Array (SKA) and the Giant Magellan Telescope (GMT).

**Question 5: Should research workforce skills be considered a research infrastructure issue?**

Research workforce skills should be considered a research infrastructure issue, as having highly skilled technical staff is essential to the operation and success of any major research facility.

Importantly, with the reliance on data across all research infrastructure, the 2016 Roadmap must consider the need for qualified data managers as a critical workforce skills issue.

**Question 6: How can national research infrastructure assist in training and skills development?**

Training should be supported to the extent that it is necessary to ensure the efficient and effective use of research facilities, and to assist the users of those facilities in interpreting their research results. Appropriate training plans should be considered as part of infrastructure operating models.

**Question 7: What responsibility should research institutions have in supporting the development of infrastructure ready researchers and technical specialists?**

Research institutions, Cooperative Research Centres and other bodies wishing to access research facilities do have a responsibility not only for training researchers but also technical specialists and operators, without which the infrastructure would not successfully function.

**Question 8: What principles should be applied for access to national research infrastructure, and are there situations when these should not apply?**

The principles of access to national research infrastructure should include:

- Infrastructure should be accessible by all categories of researchers including:
- Meritorious researchers (ie research students and early career researchers), commercial users; and/or international users, when Australian researchers benefit from reciprocal access arrangements with overseas facilities .
- Pricing and terms of access should be defined to recognise the contributions of research institutions and investors. The terms of access should be transparent to users and potential users.
- Each facility operator must provide a high level of service for users, with each facility adequately resourced to do this.
- The facility must have policies on pricing, compliance with industry standards, insurance, OH&S issues etc.

- The effectiveness of the access regime will be a key performance indicator that will be monitored throughout the life of the NCRIS program.
- Pricing should not exceed the marginal cost of providing access.

**Question 9: What should the criteria and funding arrangements for defunding or decommissioning look like?**

The Commonwealth can, and should, withdraw some aspects of infrastructure when appropriate.

Facilities should be required to establish strategies to ensure their funding is scalable, and to ensure ongoing viability or alternative funding streams. These strategies, along with strategies for decommissioning facilities, must be established during the bid phase, or early in the operation of the facility, and regularly revised.

**Question 10: What financing models should the Government consider to support investment in national research infrastructure?**

Financing models should consider the following:

- avoiding duplication
- ensuring high levels of utilisation
- attracting international collaborators.

Further, the process should encourage co-investment by state governments, institutions and commercial interests. The program structure and pricing should encourage this.

**Question 11: When should capabilities be expected to address standard and accreditation requirements?**

Where a topic is being pursued in close collaboration with industry, it is likely that industry standards will need to be adhered to. Where, for example, a baseline study relating to an environmental issue is being undertaken, with long term significance, standards and perhaps accreditation must be adhered to. Obviously all facilities must conform to the necessary standards and accreditation in health, safety and environmental issues. International research standards must also be adhered to, where relevant.

Standards are particularly relevant in relation to the role of data. Baseline data standards will need to be identified as more access is enabled and expected for use by multiple parties. Adhering to accepted standards for data formats and processing will maximise the benefits of the collected data.

**Question 12: Are there international or global models that represent best practice for national research infrastructure that could be considered?**

No response.

**Question 13: In considering whole of life investment including decommissioning or defunding for national research infrastructure are there examples domestic or international that should be examined?**

No response.

**Question 14: Are there alternative financing options, including international models that the Government could consider to support investment in national research infrastructure?**

No response.

### **Health and Medical Sciences**

**Question 15: Are the identified emerging directions and research infrastructure capabilities for Health and Medical Sciences right? Are there any missing or additional needed?**

ATSE considers that the emerging directions and research infrastructure capabilities identified in the issues paper for Health and Medical Sciences are appropriate.

'Big Data' in health is recognised as an important emerging direction, particularly in the areas of infectious disease, bioinformatics and indigenous research. It is important to consider the ethical aspects of handling this data in order to maximise the effectiveness of any infrastructure required.

**Question 16: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?**

The US Cancer Moonshot<sup>2</sup> initiative is focused on accelerating cancer research and was introduced in 2016, led by Vice President Biden. Australia's own cancer research facilities will benefit from a formalised arrangement that enables collaboration with the US program and further enables us to enhance and focus our own research in and around that of the US.

**Question 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 response.

---

<sup>2</sup> <http://www.cancer.gov/research/key-initiatives/moonshot-cancer-initiative>

## **Environment and Natural Resource Management**

**Question 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 for Environment and National Resource Management are consistent with those identified by ATSE's Fellows and the Academy supports those listed. The list would be further enhanced however, by including an integrated approach to *urban environments*. Linking environmental data (from the programs listed in the Issues Paper) to other data (eg community, health, transport) would more fully represent an integrated system that informs more efficient decision making on environmental impact, economic management and disaster response, provided that a sufficient research need for this information can be established.

**Question 19: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?**

Over the next ten years it will be important to continue contribution to field experiments, model development and other activities such as the World Weather Research Programme (via the World Meteorological Organization) and the Global Ocean Observing System (via IMOS), contributing where Australia's capabilities allow (eg ground support, algorithm development, calibration/validation).

**Question 20: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Environment and Natural Resource Management capability area?**

It will be important to ensure there are sufficient links between management of natural resources and social/behavioural issues. While this is partially addressed in *Understanding Cultures and Communities*, the value of understanding these aspects will determine future relevance and capability of research infrastructure in this area.

Further, a focus on Australia's genomic capability will facilitate broader collaboration and open up new developments in agriculture.

## **Advanced Physics, Chemistry, Mathematics and Materials**

**Question 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?**

The Issues Paper correctly identifies the emerging directions and research infrastructure capabilities; in particular it is important that Australia is in an improved position to access and influence the next generation of global astronomy infrastructure. Australia is well positioned to contribute to the new field of gravitational wave detection and study, particularly as it will spawn a rich set of research opportunities across both physics and astronomy.

An additional area to be included in emerging directions is the growing capabilities and benefits of cloud computing and data resources, with a focus on infrastructure as a service. Investment in these technologies would underpin and facilitate much of the data and data integration needs identified in the Issues Paper.

A further focus on the research infrastructure necessary to support mathematics would complement the inclusion of physics (measurement), chemistry and space science. Large scale computational models are a key element of discovery, being able to explain measured results and to increase prediction of these systems. This is critical in a very large number of other science areas and should be seen as a key enabling capability.

**Question 22: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?**

No response.

**Question 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?**

ATSE considers it could be important to consider:

- partnership in global astronomy infrastructure (eg Advanced LIGO); and
- software capabilities to support generic needs of large scale modelling.

## **Cultures and Communities**

**Question 24: Are the identified emerging directions and research infrastructure capabilities for Understanding Cultures and Communities right? Are there any missing or additional needed?**

Where there is community concern and conflict in some areas it would be appropriate to recognise these issues in the “emerging directions” section, for example, resource extraction and groundwater. The theme of “understanding cultures and communities” could provide a basis for developing new and more effective methodologies to understand and act upon community issues.

**Question 25: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?**

No response.

**Question 26: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Understanding Cultures and Communities capability area?**

No response.

## **National Security**

**Question 27: Are the identified emerging directions and research infrastructure capabilities for National Security right? Are there any missing or additional needed?**

A critical element of the national biosecurity infrastructure is the need to facilitate underpinning research within an overall national capability that ensures collaboration of both the diagnostic and research capacity in animal health and biosecurity (bringing together human, animal and plant biosecurity capabilities to meet the needs across these three sectors). The global, regional and national risks from new and emerging pathogens are growing and resources allocated to this critical area are diminishing. Any national biosecurity capability must be accompanied by sustainable funding.

**Question 28: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?**

No response.

**Question 29: Is there anything else that needs to be included or considered in the 2016 Roadmap for the National Security capability area?**

No response.

## **Underpinning Research Infrastructure**

**Question 30: Are the identified emerging directions and research infrastructure capabilities for Underpinning Research Infrastructure right? Are there any missing or additional needed?**

The eResearch and other identified components focus predominantly on hardware infrastructure; however there remain large gaps in the software infrastructure and the interoperability of software components. These are necessary to promote sharing and re-use of software and analysis components, to further support development of standards.

**Question 31: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?**

There is projected to be a massive increase in needs for complex simulation capability. For example, within the framework of a biosecurity data management capability there are specific areas that require in depth research and real time data access from multiple sources for emergency response and workable security systems that safeguard sensitive biosecurity data. Australia should position itself to access this capability.

**Question 32: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Underpinning Research Infrastructure capability area?**

The interface with Australian industry overall is not well covered in the Issues Paper and requires further consideration, including through the development of facilities that will serve the needs of science, technology, research and industry.

It is important to ensure that full life-cycle costing is developed for the planning phases with capability to process and transport data at the terabyte rate.

### **Data for Research and Discoverability**

**Question 33 Are the identified emerging directions and research infrastructure capabilities for Data for Research and Discoverability right? Are there any missing or additional needed?**

ATSE agrees with and supports the identified need for integrated research data solutions, with a particular emphasis on the need for fast connection to data archives for massive scale facilities.

These will increasingly need to be interfaced with software platforms that promote collaboration and will likely need to be serviced by data scientists with discipline expertise to ensure ready access and free integration. ATSE reiterates earlier comments relating to a need to assess cloud computing capabilities and associated data resources.

**Question 34: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?**

It may be necessary to join international projects to develop data storage and access solutions on a massive scale; however Australia should develop a global high performance research cloud to accommodate the majority of its high performance computing needs. While it is likely most regions will mount their own data centres (eg. Within Asia), Australia has the skills to provide a regional data centre which other global players could access (on the back of the SKA and optical astronomy work).

**Question 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?**

Cloud capability, which includes a focus on software platforms and software capabilities, should be included in the 2016 Roadmap for the Data for Research and Discoverability capability. These would support the generic needs of large scale modelling (model inputs, visualisation and analytics tools) and will significantly contribute to discovery on a large scale and across disciplines.

### **General Comments**

The 2016 Roadmap should focus on resilience and interconnectivity. Given the dependence of facilities and infrastructure on energy and communications networks, careful consideration should be given to the resilience, backup and stand-by capabilities of research infrastructure.

ATSE also emphasises that subsequent infrastructure planning should consider not only the capital cost of building the infrastructure, but also the ongoing operating costs (including human capital).