

# Submission

## 2016 National Research Infrastructure Roadmap

### Capability Issues Paper

<b>Name</b>	Professor Mary Kelly
<b>Title/role</b>	Deputy Vice Chancellor (Research, Development and Industry)
<b>Organisation</b>	Charles Sturt University

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

The list of Capability Areas includes a mix of specific disciplines (first 5) and overarching areas (last 2) which is unusual. If one is to assume that agriculture fits under Environment and natural resource management there is a risk that it may miss the productivity areas of agriculture. For example, climate change will impact on environment and natural resource management, which obviously has impact on the production base for agriculture, but does Australia have sufficient capability to address issues around the impact of a changed environment on plant and animal system productivity? Likewise, given recent free trade agreements, does Australia have the capability in food science to ensure products meet consumer needs in trading countries?

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

The characteristics listed appear comprehensive in nature but the real importance lies in the composition of the governance structures. For example, given the national agenda for industry-engaged research, greater outcomes focus to meet industry needs, and the proposal in this document that industry and other end-users might access the national infrastructure (section 3.5) what level of industry representation will be included in governance structures and what level is appropriate?

This also raises the question of whether or not industry investment should be sought to support the national infrastructure costs in the longer term.

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

Yes. In many cases international facilities exist that are under-utilised, so it makes sense to access these if results can be delivered in a secure, cost effective and timely manner. The opportunity to foster collaboration with international partners is an added bonus. Funding to enable access to such facilities could result in greater accrued benefits than investment of funds in infrastructure within Australia.

There is also benefit to be gained in identifying areas where Australia is an international leader and has facilities and expertise that may be attractive to international collaborators and these should be promoted at a national level. Links with overseas institutions and/or governments provide additional opportunities for Australian researchers to market their skills to foreign governments that are facing similar challenges to Australia.

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

Scenarios might include:

- Where Australia would be needlessly replicating world-class facilities
- Where the international facilities are not fully utilised, can be accessed cost effectively and accessed virtually or electronically
- Where Australia lacks the critical mass or talent to establish a globally competitive facility which would attract international researchers as users to supplement Australian use
- Where Industry within Australia can provide comparable facilities or access to comparable facilities
- Where the cost of establishing and maintaining the facilities is likely to become prohibitive or likely to yield poor return on investment

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

Yes. A combination of highly skilled technicians supporting the infrastructure on an ongoing basis, and training programs for skills transfer to research teams should be considered an infrastructure issue. There is limited funding available from other sources to support this type of skills development. Without research workforce development usage can easily drop below capacity due to the skills barrier and significantly reduce the value of the investment.

Where highly specialised capability is needed to service relatively small research communities within Australia, international access can enhance usage and provide return on the investment in skills.

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

A combination of options/schemes might include:

- Training placements/opportunities for researchers from other (non-host) organisations funded from the infrastructure budget directly or on a shared cost basis
- Training placements at national and international facilities to enhance the Australian skills base
- Joint PhD programs with a focus on training future specialists while diversifying doctoral training and training industry-ready graduates
- A key deliverable of any training scheme should be evidence of training and skills development provided through research program enhancements

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

For institutions that receive funding for infrastructure, it is assumed they seek to be leaders in specific research areas. As such, they should be prepared to invest in skills development of their researchers. For institutions that access but do not host the infrastructure or facilities, co-investment or other return on investment should be negotiated. These principles underpin suggestions in Question 6 above.

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

Access needs to be managed based on principles and/or merit. These might include:

- To support research that is in the national interest and aligned with national priorities
- Host organisations may have an agreed level of premium access but not outside of the principles agreed
- University and SME access may be considered on one set of terms, but large industry and/or international clients may be on a different set of terms
- A competitive grant or voucher scheme to award access
- Priority access for HDR student projects

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

Staged defunding is preferable to enable transition to other funding sources, while staged decommissioning is also preferable to enable time to have analyses completed if that is the only option for analyses and to prevent sample or data loss. Both options would need to be over a minimum 12-18 month period.

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

The funding model may be particular to the type of infrastructure or facility. Models might include:

- Fee for service on a tiered university, PFRA, industry and international rate scale
- Co-investment with industry, national or international
- Co-investment with other Governments
- Commonwealth funding for 3-5 years which then declines annually and is replaced by other funding sources (which will be easier to attract once a facility has been up and running and has proven its operational/business model)
- Capital from Government and resources including staff from host organisations

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

As noted above, industry and end-user linked research would be expected to fully integrate best practice and to meet standard and accreditation requirements. Investment in achieving these standards within a facility increases the diversity of organisations and groups that will be attracted as users. International recognition and use would likely be reliant on having statements of appropriate standards and accreditations.

**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*

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

*No response*

**Question 16: 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 17: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Health and Medical Sciences capability area?**

It is noted that the outcomes for emerging trends and potential new infrastructure are very human medicine focussed, whereas existing capability has a broader remit (e.g. AAHL). In deciding whether to invest in new facilities, consideration should be given to whether they have application more broadly than medicine – e.g. animal therapeutics, bioprospecting for compound which may have other uses (e.g. pesticides).

**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?**

Yes this represents good coverage but integration across disciplines is critical. For example, farmers manage a large part of Australia's land mass (and are therefore responsible for productivity and environment outcomes) but the approach to improving these has often been piecemeal (i.e. focus on one more than the other depending on funding source and personnel involved).

Investment needs to focus on integration across capability (network, virtual centres) and across industry (e.g. in agriculture grains, livestock etc.). As sensor network data becomes more common, developing e-Research capabilities to mine such data will be critical, as will investment in modelling capability. A critical overlay will be economics – most research institutions have divested capability in economics, which has limited capacity to innovate in this space and also present research outcomes in the context of economic implications. Quite often messages are presented simply, for example as \$x/ha improvement, without consideration of the financial or business risks, which may be better informed through long-term modelling based on future climate and other scenarios. Integration of the social sciences into this dialogue is also critical if we wish to see practice change – again, many institutions have divested their capability in this regard.

Consideration should be given to the location of such facilities, and also more traditional facilities for plant and animal research. Regional locations often have strong links with end and next users, making research conducted in the regions more accessible to those who will implement it. Furthermore, given much of this research needs to be undertaken in these environments (e.g. on-farm), location of researchers and infrastructure closer to end users can result in considerable cost-

savings from the traditional model of locating facilities in capital cities. It also facilitates better cross-discipline and cross-industry interaction: for example, social and economics research in the regions linked to plant and animal science research, with engagement from next and end users to ensure the recommendations emerging have traction in industry. It also creates greater opportunity for collaboration across supply chains: producers through to processors through to consumers.

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

The Food and Agriculture Organization of the United Nations (FAO) have several long-established networks for collaboration which have resulted in good progress in specific discipline areas, industries or regions. Similarly, there are good examples of international collaborations in modelling and analysing big datasets in the agricultural space, but these tend to be quite specific in focus (e.g. modelling climate, modelling biological subsystems). There is a real need to develop virtual infrastructure that facilitates a multidisciplinary approach that utilises existing and the rapidly expanding datasets provided through sensor networks, and to develop innovative modelling approaches that address the often complex issues associated with managing agricultural and environmental systems.

**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?**

Managing the environment is a dependent on people and so when considering infrastructure requirements for 'understanding cultures and communities', the capability needs of environment and natural resource management for social science expertise should be incorporated.

**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?**

*No response*

**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?**

*No response*

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

Trove is an example of the importance and value of digital humanities for communities and researchers who are not in metropolitan centres to both research and value the role of the humanities in knowledge creation. Any infrastructure that will enhance national digital humanities capacity is going to strengthen the involvement of those living and working regionally and remotely.

In terms of missing capabilities, the inclusion of regional and rural innovation and creativity and infrastructure located in non-urban and agricultural communities should not be overlooked. The emphasis in this section of the paper (p 33-36) is on urban settlements which is only part of the national dimension.

The lack of emphasis here on material culture is worrisome. The prioritisation of digitisation immediately leads to issues relating to the hegemony of societal values and the potential to extract information beyond the written or surface image is proving to be important in extracting and understanding historical culture and practice. Methods of multispectral data extraction in the last few years has shown that information can be obtained about change and provenance that cannot be obtained by a strategy of scan and dump. The storage of digital data is already presenting issues in Europe with obsolete data stratagem and data management systems meaning that digital recovery is now an issue. Finally the meta data analysis and meaningful cataloguing of data information and objects is becoming the sticking point where data retrieval is inefficient and unsophisticated.

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

One example is E-RIHS - European Research Infrastructure for Heritage Science. The Gordon Research conference on scientific methods in heritage has just occurred and had a good attendance by Australians. This points to emergent areas in First Nation heritage and cultural heritage in crisis due to war mining and lack of shared values.

**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?**

The description of material conservation points to it being regarded as a craft whereas the need is for it to be embedded scientifically. The relationship of tourism with material (not digital) culture is strong and is reliant on methods that embrace 'change' being used sensitively and in a culturally competent way. International exchange of technology and practice is a sensible way forward. Australia could take a lead in First Nation materials especially wood and skin artefacts where digital preservation is least relevant.

Enabling communication technologies, coupled with the flow of urban dwellers to regional places seeking lifestyle and tree changes are among the complexity of factors that are transforming regional and rural cultural landscapes. Regional areas have registered the most noticeable impacts of the rise of the cultural economy due to ubiquitous digital environments of creative activity rendering the physical location of the creative workforce increasingly less relevant.

Research underway at Charles Sturt University seeks to better understand the relationship between regionalism and creativity. Creative industries are not focused on urban centres alone; in fact the digital environments on which the creative industries rely means the physical location of the creative workforce is becoming increasingly less relevant. While much of the research, theory and literature on creative industries has been generated in and about large metropolitan cities, there is a growing recognition that settings of regional, rural and remote areas pose different challenges and opportunities for creative industries to thrive. Therefore infrastructure such as Trove, the NBN and digital humanities initiatives that enhance access to collections and archives and are location

independent encourages research in humanities and the creative arts to be truly inclusive and less reliant on major cultural institutions located in metropolitan centres.

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

In terms of biosecurity, the roadmap correctly identifies the need for improved biosecurity capability, and to ensure this capability is networked. The capability varies between states, as does the approach in some cases. It is imperative this capability is enhanced – the recent introduction of the Russian wheat aphid is a good example. Modelling capability will be critical here, as will social science capability (given the drivers in animal biosecurity are often more complex because owners of animals are very diverse: from farmers who manage large numbers to those who have them as pets or a hobby). Capability is often based in the cities, and given the larger numbers of animals in the regions and the potential impact on the regional industries of a biosecurity issue, capability needs to be particularly enhanced in the regions.

**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*

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

The expansion of synchrotron facilities is not emphasised in the document. The current complement of beamlines should be augmented by an ambitious programme of cutting edge beamlines that push the boundaries for automated collection, detector efficiency, ultra-small angle scattering, and laminography. The richness of Australia and Oceania for a bone fossil and cultural heritage record should be recognised and exploited by both neutron and X-ray capability. The IPANEMA facility of the Soleil synchrotron is leading the world in producing a centre for cultural heritage science built around the all-important synchrotron capability.

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

The next generation of probes for many materials will come from developments of laser technology. Free electron lasers are being developed in many countries and adapting to new technology capability for time structured and intense subfemtosecond beams. There may be an opportunity for Australia to join with or push a particular field such as "wakefield" and plasma laser sources. Terahertz capability has had a number of false dawns in terms of promise for structural data and dynamics however it may be pertinent to have waited and now collaborate on this more productively.

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

*No response*

**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?

*No response*

**Question 34:** 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 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?

*No response*

**Other comments**

If you believe that there are issues not addressed in this Issues Paper or the associated questions, please provide your comments under this heading noting the overall 20 page limit of submissions.