# Submission Template

# 2016 National Research Infrastructure Roadmap Capability Issues Paper

| | |
|---|---|
| **Submission No:** ***(to be completed by Departmental staff)*** | |
| **Name** | |
| **Title/role** | |
| **Organisation** | **AUSTRALIAN COUNCIL OF ENGINEERING DEANS (ACED)** |
| **Preferred contact phone number** | |
| **Preferred email** | |
| **Would you like your submission to remain confidential, i.e. not published on the website?** | **~~YES/~~NO** |

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

Yes, Engineering systems. A short commentary on this area is provided at the end of this response. Links to the seven capability focus areas listed are provided in answers to Q 15 – 35.

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

Governance characteristics as outlined in the Issues paper should include an explicit mention to disseminate outcomes.

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

Yes. Within the Engineering disciplines, liaison with the relevant international bodies such as Global Engineering Dean's Council (www.gedcouncil.org), the US National Academy of Engineering and the UK Royal Academy of Engineering will assist in providing access to appropriate international facilities.

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

International facilities should only be supported over national facilities only in cases where there is no local capability and no possibility of Australia developing its own capability. ACED supports the development of Australian research infrastructure as a priority.

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

Yes. Physical infrastructure needs personnel infrastructure to operate. The skills required are substantially provided by trained engineers, largely the products of the

Australian Universities which ACED represents. For ongoing sustainability of Australian research infrastructure, strong engineering programs in Australian universities must be maintained. To maintain and enhance specific research infrastructure, a strong research culture in Australian Engineering is crucial, including support for higher degree research students in Engineering.

The Cooperative Research Centre (CRC) program assists greatly the development of researchers, especially in terms of researcher capability to enter the workforce.

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

National research infrastructure may be essential for many higher degree research students but they will need direct training. Training and skills development for research students and researchers (particularly early in their careers) should be made available at suitable rates (see Q 8).

One system that is world recognised as exemplary training for higher degree research students is Canada's MITAC system. "MITAC builds partnerships between academia, industry and the world – to create a more innovative Canada"

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

The responsibility for developing infrastructure-ready researchers and technical specialists should reside with the research institution, whether they are a university or an independent research organisation such as CSIRO or ANSTO. However, universities tend to offer deeper and broader training than is feasible with specialist research institutions and this strengthens the viability and sustainability of the infrastructure in the long term.

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

National research infrastructure should be available both to researchers and also to end users in industry. Provided the access is for research purposes, access to the research infrastructure could be made available for no cost for merit-based research or at partial cost for research that does not meet the merit-based criterion. The CRC program mentioned in Q 5 is an example where research infrastructure is made available to end users.

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

Defunding without penalty is most suited to research infrastructure with a relatively high capital cost and relatively modest running cost. Some engineering systems research infrastructure is of this character. In such cases, the Australian Government funding, and associated co-investment, may be over a 1-2 year period and the

ongoing running cost the responsibility of the researchers, whether from the public or private sector. Decommissioning would only be appropriate if the infrastructure is no longer useful, which, for typical engineering systems research infrastructure, typically would not be before 5, 10 or 20 years or more.

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

ACED suggests that the current model of Australian Government funding, supported by co-investment by state and territory governments, universities and the private sector is broadly appropriate. However, it is expected that into the future, a greater emphasis be placed on infrastructure facilities that distinctively support *innovation* and are at least expected and preferably demonstrated to have substantial *impact.* Research in the engineering disciplines is typically characterised by being both highly innovative and of high and ongoing impact.

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

The engineering disciplines lead the way in developing, maintaining and adhering to a wide range of standards, both at the national and the international level. Australian engineers have a substantial track record of which they are rightly proud in contributing to international standards in a wide range of fields, including structural and mechanical engineering systems, telecommunications and software systems, and environmental systems. This model should certainly be extended to other areas where it is hitherto lacking.

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

The German Fraunhofer Institute may provide useful models.

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?

Again, the Fraunhofer Institute may provide useful information.

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

A co-investment model is recommended, with an increasing emphasis on innovation and impact. The German Fraunhofer Institute, again may provide a useful model.

**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?

The role of engineering in general and biomedical engineering in particular should not be overlooked in this space. Vast improvements in public health have resulted not only via 'Health and Medical Sciences' as such, but by such engineering infrastructure as clean water supplies and effective removal and treatment of waste water. Medical devices, such as the cochlear implant, artificial heath pump, tissue repair are the products of multidisciplinary research including engineers. Robotic and haptic systems are already finding their place in medical procedures, and for supporting age care. Engineering systems, underpinned by research will continue to provide cost-effective and widely deployable tools in the improvement of public health and well being.

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 Comment.

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?

As mentioned in answer 15, the impact of Engineering in contributing to public health outcomes needs to be recognised. Investment in new engineering materials for new medical devices is also a high priority.

**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?

Engineering survey methods and capabilities will contribute to all of the identified emerging directions.

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

No Comment

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?

No Comment

**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?

Engineering has a vital role to play in developing and proving the advanced instrumentation required by the Physics, Chemistry, Mathematics and Materials

areas. Apart from specific Instrumentation Engineering, Electrical, Electronics , Communications and Software Engineering are all important in this respect.

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 Comment

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?

Engineering is the 'enabling' technology for much of the development of the advanced instrumentation underpinning these sciences.

**Understanding 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?

More emphasis might be placed on emerging and growing human-machine interfaces, such as wearable computers, human-machine relationships, and bionic engineering, driverless vehicles, drones and the way such technologies impact personal and community interaction.

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 Comment

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 Comment

**National Security**

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

Informatics and information technology is at the heart of cyber security and Australia's infrastructure in this area, and our software engineering capability needs to stay in touch with or ahead of international developments. This is particularly so in the area of quantum computing.

Energy security is the particular interest of Electrical and Power Engineers. Large-scale test facilities for the reliability and quality of power supplies need to be upgraded.

Energy security in terms of the supply of liquid fuels for the nation needs to be recognised as potential risk to the country's function, operation and economy

Water security in the first instance is the responsibility of Civil and Environmental engineers, who require access to state-of-the-art infrastructure facilities.

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

Australia would benefit from 'buy-in' to large engineering projects in emerging economies in Asia, Africa and South America.

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

No Comment

**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?

With respect to cyber security (see Q 27), ACED supports the development and maintenance of high performance computing infrastructure and associated high bandwidth network infrastructure. ACED also supports the development and enhancement of reactor and accelerator technologies and the associated engineering infrastructure.

Question 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

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 Comment

**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?

ACED emphasises emerging trends in energy security, energy diversity, driverless vehicles, big data, machine-human interactions and new materials and devices.

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 Comment

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?

**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.

The following paragraph explains the additional capability area proposed. ACED will be pleased to discuss this further.

**Engineering systems**

Engineering is characterised by systematic problem solving through purposeful design, driven by some visualised human need. Increasingly important areas for engineering solutions lie in climate change mitigation, energy and transportation systems, urban planning and construction, agriculture, environmental quality, advanced manufacturing, computational and communication systems, and biomedical and bioinformatics systems. Engineering science research is likely to require and exploit research infrastructure in most (if not all) of the seven identified capability areas. While some engineering problems that formerly required hardware implementation for development and testing of solutions have now been superseded by computational modelling, it remains the case that in many cases real physical infrastructure must be constructed to calibrate and validate the models.

ACED therefore urges the addition of engineering systems as an additional capability area for research infrastructure to adequately support research solutions at the scale and standards that can add high economic and community benefits. Many of ACED's member engineering faculties operate facilities in specific areas (such as structural and aerodynamic testing, bulk materials handling, advanced manufacturing, etc.) often created by national funding schemes (see Qu 9) and maintained by grant and industry support. Such facilities need to be maintained and supplemented to the highest possible standards in areas of national importance, and be brought into the national research infrastructure inventory.