2016 National Research Infrastructure Roadmap Capability Issues Paper: AMMRF Submission

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AMMRF Nodes 2007–2016

AMMRF linked labs

2007–2016 funding

Summary

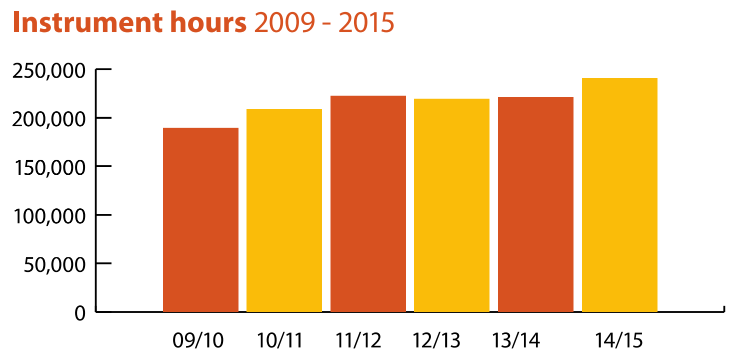
The AMMRF is mature and successful collaborative infrastructure. It includes eight university-based core microscopy facilities and a range of other microscopy centres. Together our nodes strategically invest in microscopy infrastructure, including instrumentation and expert staff. This collaboration prevents duplication and maximises productivity.

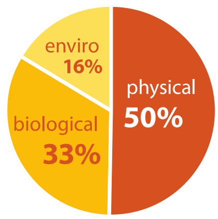
We make over $200M worth of instrumentation openly accessible to all Australian researchers, both within and outside of the AMMRF network. By supporting flagship instrumentation, NCRIS provides Australian researchers access to specialized tools that are often beyond the scope of individual universities or the ARC.

The AMMRF annually supports
3000+ researchers
1000+ publications
100,000+ online resource users
$200M open access instrumentation
100+ industry clients
19% of 2015–16 users are formally linked to industry

Without the support of NCRIS, the universities would have no incentive to make their comprehensive core facilities openly available to outside users. They would compete and likely duplicate resources leading to inefficiencies in the use of public funds. Most importantly, academic and industry researchers would no longer have access to the advanced microscopy tools and expertise needed to support Australian innovation.

We enable high-impact research – over 1,000 publications per year. Four AMMRF-enabled papers were published in the top journal, *Nature*, within the last year. Almost 20% of our users have formal industry links through industry-supported research partnerships or are direct commercial clients. We have developed MyScope™, the world's leading online training for microscopy, with over 100,000 users each year. From training and data collection, to analysis and publication – our infrastructure supports Australian research across a wide range of disciplines.





Users by discipline 2014–15

Game-changing microscopy technologies are emerging that will be crucial for Australian researchers in the coming years. These capabilities have not been mentioned in the Capability Issues paper:

- **Cryo-electron microscopy**: new technology that enables very high impact research across the biological and medical sciences, especially in the field of structural biology, to direct intelligent drug design against targets identified by gene sequencing and the other 'omics;
- **Atomic scale microscopy**: new generation tools are now, for the first time, consistently able to access information about the structure and bonding of matter at the atomic scale, enabling the design of advanced materials valuable to industries such as electronics, chemical processing, manufacturing and mining; and
- **High sensitivity microanalytical tools**: includes new technology for isotopic analysis that is able to provide more accurate mineral dating and structural analyses for the resources industry, support research into sustainable agriculture and even help understand lunar forming events.

These capabilities are crucial for Australia to maintain a world-leading position in research in medical, biological and materials science, agriculture and geosciences, addressing important global and local challenges.

The AMMRF has prepared a strategic five-year plan to:

- acquire, develop and provide access to these infrastructure capabilities
- strategically place instruments aligned with areas of technical expertise and relevant user groups to produce high-quality research outcomes
- transition support for older infrastructure to host universities.

This plan provides an up-to-date national infrastructure network to ensure all Australian researchers have access to these important emerging technologies.

This future focused national facility will also incorporate:

- enhanced support to address emerging challenges in data and informatics (sharing expertise through a combined AMMRF/NIF Data and Informatics Committee)
- a stronger industry engagement plan, including support for start-ups and small businesses
- Australian access to world-first technology through microscopy technique development
- expansion of our world-leading MyScope™ eLearning tools
- a node at Monash University to provide open access to infrastructure based in Victoria.

Responses to Questions

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

We believe these capability focus areas are comprehensive.

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

We believe these governance characteristics are appropriate.

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

See response under question 4.

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

Conditions for access to international facilities should be based on current and projected demand and future economic impact balanced against the cost of establishment, maintenance and decommissioning. The AMMRF scrutinizes Australia's need for microscopy and microanalysis capabilities at a national level. Connectivity between nodes, a deep knowledge of users' research needs and expert international input position the AMMRF to strategically assess the need for national capabilities vs usage of/investment in international capabilities.

Researchers using microscopy travel internationally or collaborate with colleagues abroad for projects that require highly specialized infrastructure, or to take advantage of specific expertise. An example of an international capability that is not available in Australia is in-situ ion-irradiation with transmission electron microscopy (TEM), which is used for assessing the radiation tolerance of materials for nuclear reactors or waste storage. Although Australian researchers currently travel to access this capability at the Argonne IVEM-Tandem Facility, USA, we do not believe the extent of Australian demand warrants duplication of this infrastructure in Australia.

With the exception of such highly specialized cases, microscopy capabilities should be domestically available. Microscopy experiments are normally carried out over a long period of time (in parallel with other experiments) and users are normally trained to operate the instruments independently. They are generally not suited to short visits. Also, life science samples are often not transportable (degradation and AQIS issues). We do not believe the extent of international usage warrants national research infrastructure investment in overseas microscopy facilities, but access to a general fund to apply for costs associated with access to such specialised facilities would be most welcome.

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

See response under question 7.

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

See response under question 7.

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

The high-level training and retention of expert technical staff is an essential component of research infrastructure. The AMMRF's experience has been that new-generation equipment is not effectively used in research unless dedicated technical specialists are available to assist researchers in getting the best possible outcome from their research. This technical expertise has to be maintained long-term in order to avoid downtime and excessive costs for re-training.

While the host institutions play a role in educating many of the staff that we recruit, the AMMRF takes the responsibility for staff development and user training. The federal government investment provides the incentive to create an open-access infrastructure for Australia and for the laboratories to share best practice around training, staff development and facility management.

It is essential to consider the role of career development in the retention of skilled technical staff. This requires continuously updating their technical expertise and the development of skills in laboratory management. The AMMRF offers Masterclasses, which are advanced workshops for technicians and expert users of specific microscopy techniques. The skills involved with research infrastructure are highly specialized, so staff also benefit from international exchanges of expertise that are facilitated by specific MoUs with EuroBioimaging and Nanyang Technological University in Singapore and through our partnership in Global Bioimaging.

Within the AMMRF we have harnessed our cumulative expertise to develop world-leading online training tools (MyScope™) that lower the instrument time required for training, freeing it up for research use. These web-based learning modules not only support the training of researchers who use our facilities, but are freely available online and have built Australia's reputation for excellence in microscopy training internationally. MyScope™ has recently been shortlisted for the *Best blended learning project - public and non-profit sector* in the international Learning Technologies Awards.

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

The AMMRF open access model provides merit-based access to research infrastructure. Candidate projects are discussed one-on-one with users to ensure the research is of merit, the experimental plan is sufficient to provide a quality outcome and the users have selected the correct technology to answer the questions they are asking.

The AMMRF believes that it is appropriate to charge fees to access our infrastructure. Fees encourage researchers to use these valuable facilities efficiently, but are set low enough (i.e. subsidised), so that they do not pose a barrier to access. Industry users are able to access the facilities at commercial (but still accessible) rates.

In the future, special consideration, in terms of subsidized access fees, will be applied to innovative start-ups and SMEs to encourage usage of national research infrastructure by researchers based in resource-poor early stage companies.

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

The AMMRF has a rolling 5-year plan that involves transitioning support for older equipment to the host universities to make way for new-generation equipment with new capabilities to be funded by NCRIS. The 5-year plan also involves transitioning funding to new technical experts or re-training of existing specialist staff on the new equipment.

The AMMRF collects information across its user base to determine requirements for new technologies, and situations where it is appropriate for the host institutions to take over the full cost of managing previous-generation flagship instruments. All equipment within the AMMRF nodes will remain accessible under the AMMRF's open access policy.

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

It is essential that the Federal government has ongoing involvement in national microscopy infrastructure initiatives. Infrastructure-related collaboration and co-funding with other institutions requires confidence that the initiative remains important to all stakeholders. Ongoing investment from the federal government as the "foundation investor" provides the confidence for funding from other stakeholders. This support can be leveraged through co-investment from research institutions, state governments, granting bodies and, where appropriate, industry. Without federal government involvement, potential co-funders such as universities are likely to abandon open-access projects, leaving Australian researchers without access to the microscopy infrastructure they require.

Australian institutions cannot afford to compete with each other. Replicating the same infrastructure leads to multiple, local and diluted investments that fail to realize the full capacity of the technology. Investments need to be strategic. A grid consisting of high-end 'flagship' platforms and associated technical experts in strategic locations, supported by mid range tools that feed into these high-end instruments, is an efficient way to deliver Australia's microscopy needs. The table below compares the benefits of a federal co-funding model, compared to the case of a facility supported wholly by the universities.

Federal co-funding model **Delivered by the AMMRF**	**Local funding model** **Delivered by the Universities**
National planning - Ability to devise and manage an infrastructure plan of significant scale that **maps to the national Strategic Science and Research Priorities.** - **Full utilization** of greater variety of infrastructure investments.	**Local planning** - **Competition** between universities for access to government funding to purchase the same high-end infrastructure. - Multiple installations of similar equipment that is **underutilized.**
AMMRF subsidized = **national access** - Strong incentive to **open access** to all Australian researchers (i.e. other universities, PFRAs and industry). - Permits low fees to enable a wider range of users, including early career researchers. - Subsidized access to innovative startups and SMEs **(we currently have 1:1 usage ratio between SMEs and large industry).**	University funded = **local access** - "Our" money paid for "our" equipment, access limited to "our" people. - No incentive to allow access to researchers from other universities/PFRAs - Limited ability to offset decreasing value of research grants. - No incentive to allow access to startups and SMEs (can't afford standard industry rates).
National skill support – increases quality of research Australia wide Expertise and best practice shared amongst AMMRF's research nodes, improves delivery of capability at each node. Level of expertise reaches **a similar, high level of common capability across all nodes.**	**Local skill support – no shared expertise** Little inducement to connect & share expertise nationally. Overall **lower quality** of technical capability across Australia.
Shared procurement plans – **costs down** AMMRF staff strategically working together on procurement of instruments, consumables and spare parts, yields pricing discounts.	Isolated procurement plans – **higher costs** No ability to leverage higher volume orders to decrease costs.
Standardization across Australia Development of best practice - laboratory management and operations, including, occupational safety standards and procedures as well as maintenance of equipment. **AMMRF protocols are adopted world wide – our facilities are providing world-best-practice.**	Limited standardization
Ability to **leverage diverse sources of co-funding**, including state governments.	Limited co-funding sources available (co-funders follow federal government funding).

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

Standards and accreditation requirements should only apply to research facilities where to do so adds value to the output for the majority of users. Accreditation requires significant extra cost associated in set up and maintenance of a quality management system and payment of annual audit fees. The application of standards and requirement for accreditation would apply more generally to organizations supplying analytical services to industry, rather than first stage research services.

Our University of Western Australia node is a member of the International Atomic Energy Agency's Network of Analytical Laboratories. This membership was based on a lengthy qualification process that involved the development of a thorough quality management system, tests on blind samples, and a site visit. It is based on ISO17025, but not accredited. The IAEA does not insist on accreditation, as they acknowledge that many labs would be unable to participate due to the high costs of maintaining accreditation.

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

Most countries that invest substantially in research fund microscopy at a national level. In the US, the US Department of Energy federally sponsors National User Facilities that are available for external use to advance scientific or technical knowledge through their program supporting Nanoscale Science Research Centers (NSRCs). Under this program, a network of National Microscopy Facilities is supported at the Lawrence Berkeley, Argonne, Oak Ridge, Sandia, Los Alamos and Brookhaven National Laboratories.

Some countries concentrate federally-funded high end microscopy facilities in single locations such at the UK SuperSTEM (National Facility for Aberration Corrected STEM) or the Ernst Ruska-Centre (ER-C) for Microscopy and Spectroscopy in Jülich, Germany. The AMMRF believes that a distributed model is more appropriate for Australia, given our geography, and the differing research strengths within our institutions. Appendix B is a *Nature Methods* editorial piece from August 2016 that discusses the benefits and the funding models for international core microscopy facilities.

The AMMRF has a strong history of fostering national and international collaboration and is a model for best practice, with an open access policy consistent with the NCRIS goals. We have a world-best model for open access to a broad range of research infrastructure and a 5-year rolling plan for acquisition and distribution of newly developed high-end equipment in a national network of collaborative nodes.

In Europe, the European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences (Eurobioimaging, http://www.eurobioimaging.eu) is an initiative funded by the European Commission and their Horizon 2020 program that provides physical user access to a broad range of state-of-the-art technologies in biological and biomedical imaging for life scientists, and is widely acknowledged to be based on the AMMRF model.

We suggest continuing the successful existing Australian expertise and models of collaborative engagement that are being adopted world-wide.

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?

As described earlier, the AMMRF's 5-year plan includes phasing out support for (i.e. defunding) our older flagship instruments (see response to Question 9 and Section 9 of our 5-year plan in Appendix A).

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

There is no alternative financing model for this infrastructure. Without access to support from a national research infrastructure funding scheme, and the associated co-investment, microscopy infrastructure would need to be funded wholly from universities and ARC LIEF. Individual institutions would begin competing with each other and replicating under-resourced infrastructure. Under any other scenario, it is unlikely that Australia could provide the level of microscopy support that is required by our research community.

Large international microscopy resources are funded by the relevant country's government or, rarely, by large philanthropic donations (the AMMRF is exploring this option, but it is not yet a viable alternative for fully supporting Australian infrastructure).

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?

Cryo-electron microscopy is an extremely important emerging technology that is needed to support research in medical sciences (see Appendix A, AMMRF 5-Year Plan, section 4.2). Recent commentary in the top journal *Nature* describes the impact of the new-generation cryo-electron microscopy technique as nothing short of a revolution[1], describing single particle cryo-tomography as the most significant development for structural biology since X-ray crystallography. Thanks to recent hardware and software breakthroughs, this technique can now reveal the hidden machinery of the cell with unprecedented, near atomic resolution. This provides information about how molecules involved in disease might be targeted with strategically designed drugs. In the coming decade, researchers across Australia will require increasing access to these advanced techniques, which require not just an instrument, but a whole ecosystem to provide an end-to-end solution across the cycle of these complex experiments.

Another exciting new research capability is development of multi-modal techniques that allow the in-situ elemental mapping of biological/medical samples without labels; this technology exists in principle and is widely used in the materials sciences but for soft matter is prone to artifacts due to limitations in sample preparation methods. Cryo-imaging platforms in combination with mass

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[1] E. Callaway, "The revolution will not be crystallized: a new method sweeps through structural biology." ***Nature*** 525:172-174 (2013).

spectroscopy would provide a quantum leap in terms of identifying components of malfunctioning cells and tissues.

To provide cryo-microscopy to all of the Australians who need it, a national approach is needed. Mid-range machines can be used to collect high – but not the highest – quality data, and to identify suitable samples to be examined on openly accessible, state-of-the-art instruments. A national approach is also required to tackling the significant data management challenges associated with this capability. Our 5-year plan sets out how we aim to implement such a service (Appendix A, Section 9).

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

We recommend participating in Global Bioimaging, an international network of collaborating infrastructures in biological and biomedical imaging for life scientists supported by the Horizon 2020 program. Its goal is to establish a sustainable network of international infrastructure partners to allow common access programs to their services and exchange of best practice. Facilities will become interoperable with other international imaging infrastructures in their user services by standardization and harmonization of access protocols, methods, and training programs as well as image data formats, analysis software and management. The AMMRF and the National Imaging Facility are founding partners in this initiative.

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?

See response to questions 15 and 16 above.

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?

Tools for high-precision isotopic analysis of minerals have evolved enormously in recent years and are essential to understanding the mineralization processes of the ore bodies that underlie Australia's resources industry. As an example, our geologists require access to new-generation secondary ion mass spectroscopy (SIMS) to remain at the top of their field. In particular, use of new ion sources with an order-of-magnitude increase in brightness promise massive improvements in lateral resolution with no decrease in sensitivity. This will be of particular use for dating zircons by analysis of oxygen isotopes and for measuring sulphur isotopes in sulphide minerals, both of which are important for developing more efficient exploration strategies for economically viable ore deposits. It will also contribute to work in nuclear safeguarding with the International Atomic Energy Agency (IAEA).

The AMMRF's rolling 5-year plan currently includes provision for world-class open-access national microanalysis facilities (see attached Appendix A, AMMRF 5-Year Plan, section 9), including an updated SIMS capability in Western Australia.

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

See response to question 16 above.

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?

Microscopy is an underpinning technology for much research in these disciplines. The AMMRF provides open access to infrastructure used in research projects in agriculture and soils, mineral exploration and extraction, environmental remediation, water purification systems, renewable energy, the changing marine environment, pollution and next generation sensors.

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?

Atomic scale microscopy is an essential technology for materials, nanotechnology and chemical research. As our engineering of materials proceeds to the atomic scale, materials design increasingly requires knowing exactly which atoms are where and how they are bonded. Breakthrough aberration correction technology has recently improved the resolution limit of the world's highest resolution electron microscopes to provide much greater clarity at the atomic scale: the scale at which many structure-function problems can be addressed. Atom probe tomography is a complementary approach that provides atomic information with high sensitivity in 3D. A very broad range of researchers across the country will depend increasingly on access to atomic scale microscopy technology, to enable atomic-scale design strategies to be developed for new high-value materials with impacts on industries such as electronics, chemical processing, manufacturing and mining.

High-end aberration corrected electron microscopes and atom probes are expensive, and require a great deal of supporting infrastructure. It is impractical for institutions to replicate them. As described above for cryo-electron microscopy, the AMMRF have developed a plan to host a national atomic-scale microscopy capability consisting of a grid of strategically located high-end open-access facilities supported by mid-range instruments in a wider range of locations (see Appendix A, AMMRF 5-Year Plan, section 9).

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

See response to question 16 above.

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?

See response to question 21 above.

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?

Microscopy is an enabling technology for research in this discipline. High sensitivity and 3D instruments enable research projects in archaeology and increasingly in art and cultural artifact analysis and conservation. For example, high-profile research at the University of Queensland, in collaboration with a large international consortium, has contributed information valuable for the development of strategies for the conservation of Van Gogh's, and other significant paintings of the nineteenth and twentieth centuries. Also, ongoing archaeological research is revealing previously unknown aspects of ancient Greek metallurgical practices.

Digitisation of important collections is also an area where microscopy techniques such as X-ray microtomography and scanning electron microscopy are playing a crucial role. They are able to generate 3D digital images and prints of valuable and fragile objects that can then be displayed and studied further, either as solid objects or as an online digital dataset, potentially available to all.

The microscopy and microanalysis instruments that museums require for this work are often beyond the scope of the organisations to purchase. Centrally-located open-access facilities, made possible through the AMMRF, allows the provision of high level analytical services and equipment for digitisation projects at accessible rates.

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

See response to question 16 above.

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?

See response to question 24 above.

National Security

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

Microscopy is an enabling technology for biosecurity, particularly for research into emerging viruses and disease threats to humans, livestock and native wildlife and the development of vaccines and treatments. The CSIRO Australian Animal Health Laboratory (an AMMRF linked laboratory) has high-resolution electron and confocal microscopy capabilities and the necessary highly skilled staff housed in the highest-level containment facilities in the world. They are capable of handling and investigating the most dangerous human and animal pathogens. Microscopic analysis is often the first and quickest method for identification of unidentified potential biosecurity threats. Rapid biological methods can then be developed for identification in the field.

As an exporter of uranium, Australia has a responsibility to contribute to global nuclear safeguards (i.e. detection of the diversion of nuclear material for the purpose of making weapons). The Asia–Pacific region would become destabilised if DPRK develop nuclear weapons, and it is in Australia's best interests to contribute to measures to prevent this. New SIMS technology that the AMMRF propose to install at UWA is able to provide uranium isotope measurements of environmental samples for nuclear safeguards. Supporting the type of analytical infrastructure necessary to assist the IAEA with verification is a small but significant contribution.

Quantum computing is a developing technology that will facilitate powerful encryption and other sophisticated algorithms to enhance our cybersecurity. Research on the materials underlying quantum computing depends on atomic scale microscopy to understand their structure and behaviour at this scale. In particular, aberration corrected transmission microscopy and new-generation atom probe microscopy tools with high-yield detectors are required to resolve the tiny structures that display quantum behaviour. Australia's quantum computing researchers will be unable to remain at the leading edge without access to these tools.

The AMMRF has established a 5-year plan that outlines the provision of essential infrastructure to support these research areas (Appendix A).

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

See response to question 16 above

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

See response to question 27 above.

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?

Microscopy and microanalysis technologies underpin an extremely broad range of research areas, and should be considered underpinning research infrastructure. Access to the latest generation advanced microscopes is essential for medical science, materials and nanoscience, geoscience, plant science, biological and soft matter science. Research in these fields can be mapped to all of the Chief Scientist's Strategic Science and Research Priority areas (Appendix A, see section 3.3).

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

See response to question 16 above.

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

We suggest that the 2016 Roadmap for the Underpinning Research Infrastructure capability area should include provision of a national grid of open-access microscopy facilities with high-end 'flagship' platforms at strategic locations, supported by a grid of accessible instruments located across Australia.

The AMMRF has prepared case studies to highlight the breadth of outcomes made possible by open access to these capabilities under the AMMRF model, included as Appendix C:

- Life – the big questions: identification of the earliest undisputed life on Earth.
- Microscopy innovation builds industry: New microscopy technology leads to tech start up that is sold for $76 million.

Another case study is available at the link below

- NCRIS case studies – Giving Australia a competitive advantage in global steel markets https://www.education.gov.au/giving-australia-competitive-advantage-global-steel-markets

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?

Microscopy and microanalysis are producing ever larger data files due to the increasing richness of data obtained from contemporary techniques, e.g. the increased digital and spectral resolution of modern detectors, and the transition from probing systems in two or three dimensions toward the routine acquisition of 4D and 5D data arrays where compositional and time-resolved information are superimposed onto spatially resolved data sets. In addition, microscopy techniques are increasingly generating internationally significant data, warranting sharing and re-use. There are many parallels between the type of data generated by microscopy and imaging, and the two communities face similar data-management challenges. As a part of this roadmapping process, AMMRF and NIF propose to create a combined Data and Informatics committee to minimise duplication of resources and to align strategies where this will lead to efficiencies.

The AMMRF already have a plan for a national approach to data management (Appendix A (see section 4.3). Success with this plan will require infrastructure to support data acquisition and high-speed data transfer, secure storage that allows sharing in a controlled way (through authentication or registration) and the capacity to undertake cloud-based data analysis on stored data. Most importantly, successfully achieving a national data solution requires node-based data and informatics engineers to implement solutions and to provide expert advice and support to AMMRF users. The AMMRF has collated data and informatics needs nationally from all of its nodes and would be happy to work with government to provide a central resource for communication on this front.

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

See response to question 16 above.

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?

See response to question 34 above.

Other comments

For more information see our website ammrf.org.au, or contact us on 02 93514493.

Appendices

Appendix A: AMMRF 5-year Plan

Appendix B: Nature commentary referred to in response to question 12

Appendix C: One-page case studies referred to in response to question 32