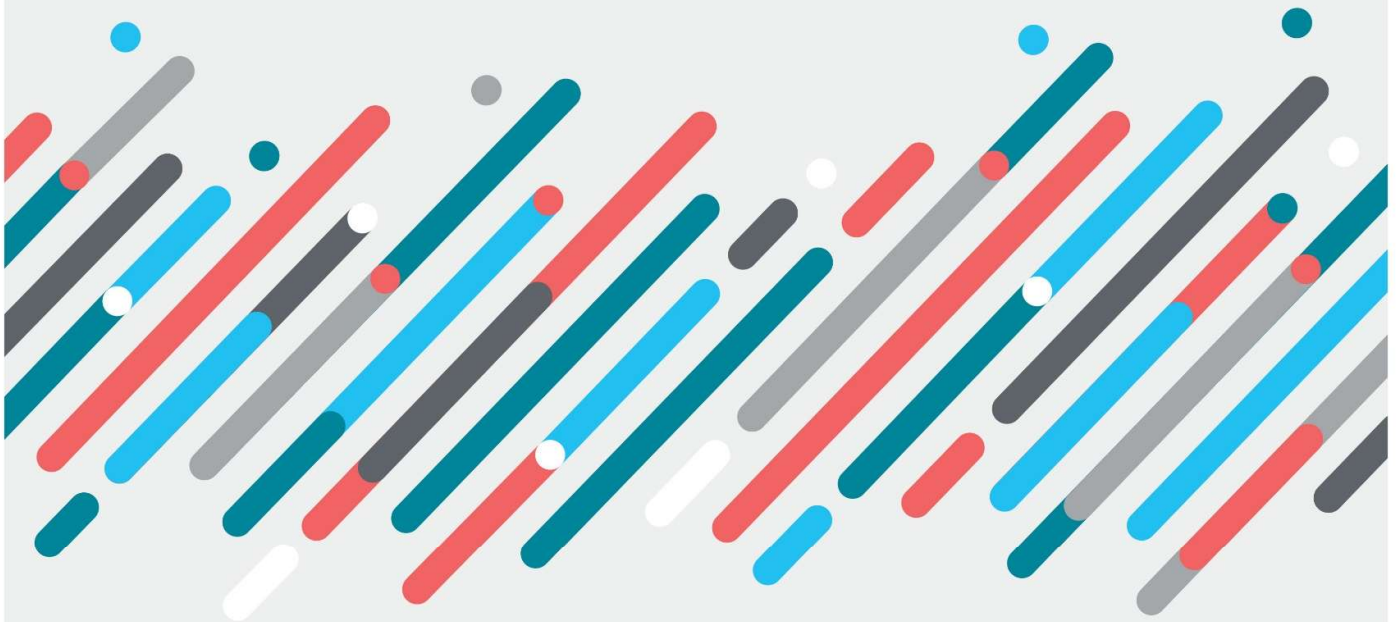




Australian Government
Department of Education

National Digital Research Infrastructure (NDRI) Investment Plan Consultation Survey

Preview



Data

Q1 - What investments could support wide-ranging uptake of FAIR and CARE principles by Australian researchers?

Supporting FAIR and CARE principles does not necessarily require a specific infrastructure investment, rather a commitment from all research and infrastructure funded entities to embed and uphold the principles. This could be made a condition of funding from funding bodies, with reporting requirements on actions taken to support the principles.

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Q2 - What investments can be considered to address the barriers identified in the NDRI Strategy (pages 16-17)?

Fundamentally, the core responsibilities rest with researchers and institutions to set up data structures (metadata etc), storage and management systems appropriately to ensure research projects and outputs are ethical and deliver collective benefit. Funding responsibility also rests with research projects and institutions – funding best practice (and indeed, minimum standards) should not be relegated to a call for NDRI to ‘fix’ issues in the research system. However, NDRI funding could have a limited role in targeted support to agreed metadata standards (where there are no other processes to convene and there is significant and wide national and international benefit), provide advice on how to ensure datasets are interoperable and potentially provide a repository for research data information, e.g. storage locations, overview of consent and authority to facilitate access to data. However, the role of NDRI should not be confused or deflect from all researchers and institutions’ own responsibilities in supporting systems that enable FAIR and CARE.

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Q3 - How can future NDRI investments ensure recognition of the importance of data self-determination and the principles of Indigenous Data Sovereignty, in alignment with the Australian Government's Framework for Governance and Indigenous Data?

This would be best managed on a contractual and grant basis. NDRI (or NCRIS) funding contracts could include a commitment from facilities to use and implement CARE/FAIR practices, an agreement to be subjected to periodic audits. NDRI facilities would also require all researchers to uphold set CARE/FAIR standards, and that future access for researchers and their host institutions could be terminated or sanctioned if these standards are not upheld. A similar statement and conditions could be made a condition of all national research grants and research block grant funding. Financial levers and sanctions are often the most successful in changing culture, including in the research system.

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Q4 - What are the priority data-related NDRI investments that would enhance Australia's research efforts?

The primary consideration in allocating NDRI funding for ‘data’ is to establish: a clear and consistent definition of what is meant by ‘data’; what is nationally significant data in the NDRI context; and what should be considered to be in scope for NCRIS/NDRI as opposed to being the



responsibility of state/territory, PFRAs and other Government agencies, or institutions to manage, potentially in perpetuity if necessary. This will limit cost shifting and focus areas of primary responsibility and funding responsibility. As research becomes ever more digitally intensive, business as usual research practices will continue to generate increasing quantities of data. This should remain the responsibility of researchers and institutions to manage and not be conflated with a NDRI need or funding requirement. However, NDRI funding is appropriate to manage and curate nationally significant datasets – data that many researchers access and require to conduct their research. Drawing a strict and consistent boundary for what constitutes a nationally significant dataset is essential to ensure NDRI funding does not get diluted (and wasted/misused) on data management concerns that should remain the responsibility of researchers and institutions.

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NDRI for Humanities, Social Sciences and GLAM

Q5 - What are the gaps and weaknesses in Australia's NDRI landscape for our humanities, social sciences and GLAM sectors?

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Q6 - How can NDRI investments support the creation, management and access to digital twins?

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Q7 - What international exemplars of large-scale research infrastructure investments to support the humanities, social sciences and GLAM sectors do you recommend Australia should consider as part of the NDRI Investment Plan?

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Q8 - What are the priority humanities, social sciences and GLAM NDRI investments that would enhance Australia's collaborative research efforts?

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Compute and AI

Q9 - What are the current gaps and weaknesses in Australia's NDRI technological capabilities?

Australia's two Tier 1 HPC research facilities, NCI and Pawsey, are both dangerously approaching failure points. NCI's Gadi machine is near end of life, and requires a secure funding commitment



of ~\$100 million within 6 months for necessary upgrade procurement procedures (procurement/installation can take up to 18 months). This machine underpins critical work across Australia's research community and several Government agencies. Without it, essential climate modelling, mission-led research within Government PFRAs (GA, BOM) and other publicly funded research (e.g ARC Centres of Excellence, NCMAS work) can not be done. Pawsey Supercomputer needs ~\$50m upgrade funding commitment in the 2025-26 financial year. This facility is foundational to international astronomy commitments, including the Murchison Array and ASKAP and supports Australia's research community through NCMAS allocations. Tier 1 HPC delivers high levels of compute speed, efficiency and availability - as such, it is generally used for critical or highly sophisticated research problems and high-demand applications. Both NCI and Pawsey supercomputers are coupled with co-located high-performance data. This optimises the machines' ability to process the data and achieve maximum output and value. Given the urgency of Australia's Tier 1 systems' upgrade needs, NDRI funding must focus on the critical near-term funding needed to keep these facilities functioning. Securing current capability for the next 4 years will require ~\$300m. This aligns with evidence on upgrade costs given to the recent Adopting AI Senate Inquiry. Uplifting current HPC infrastructure, data, software and AI-enabling capabilities support globally competitive research and boost economic activity will cost ~\$850m. These amounts are the required operational support from NCRIS. Co-investment will also be required.

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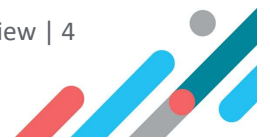
Q10 - What should Australia's supercomputing/high-performance compute landscape look like in 5 years from now?

A sustainable, functional HPC landscape in 2030 would include a suite of HPC facilities at different scales and architectures. There will be a single governance and access structure to streamline user access and manage planning of capital, skills and software development at a national level. NCI and Pawsey would be operating at full capacity, with green energy supply and complete with upgrades to ensure they can process huge amounts of data produced by emerging fields and instruments (e.g. ASKAP and Murchison telescopes) as well as teams of expert software engineers to work with researchers to refine and maximise the efficiency of code from a processing and power perspective. A 10-year plan will be in place, which includes considering support for other Tier 1 nodes, or regional Tier 0, as well as alignment with a sovereign AI capability plan. There is a clear threshold set to determine the appropriate level of Government support for Tier 2 facilities, considering the level of national need and federated administration. Rather than the current ad hoc and piecemeal approach, Australia's HPC capability will have a targeted and dedicated budget allocation to provide surety and transparency to funding. To build this ideal HPC landscape, a clear understanding of current and projected national HPC demand (as well as data needs) must be established – and the critical upgrades needed at both NCI and Pawsey must first be secured.

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Q11 - To what extent should NCRIS investments extend to Tier-2? What would make these "collaborative" and "national"?

Tier 1 HPC delivers high levels of compute speed, efficiency and availability - as such, it is generally used for critical or highly sophisticated research problems and high-demand applications. Both NCI and Pawsey are coupled with co-located high-performance data, optimising the machines' ability to process the data and achieve maximum output and value. Australia also has several Tier 2 facilities that support national programs, individual institutions and research projects. Tier 2 facilities, while an essential and nationally important component of Australia's HPC capability are,



by definition, not at a national scale; they are housed and maintained predominantly at an institutional level. They are undoubtedly accessed by and of significant benefit to several different research groups and projects, including beyond their home institution. But they are generally at a scale where they should be funded through institutions, or consortia of institutions, rather by the Commonwealth. However, as research increasingly digitises, calls for NDRI to service needs at or below Tier 2 will increase. Also, some Tier 2s have or will in time support national initiatives that enable Australia's ability to access or participate in important global collaborations, particularly in astronomy. Some projects may later require access to Tier 1 capabilities as they progress. Ensuring access to HPC at a range of scales and architectures should be an additional NDRI consideration.

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Q12 - To what extent should future investments consider AI sympathetic architecture?

AI and machine learning architectures do and will continue to have significant benefits to HPC requirements, and AI sympathetic architectures should be considered as part of the commissioning processes. It is noted that the consideration and reliance on AI architectures will likely be similar to the distinction between CPU and GPU architectures, and will be important considerations in a HPC strategic in planning and coordinating the suite of interconnected HPC facilities.

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Q13 - How can Australia sustainably invest in new NDRI technologies that align with the Australian Government's Net Zero greenhouse gas emission target by 2050?

To align NDRI investments with Australia's net zero commitments, procurement processes for HPCD investments should be leveraged to use renewable energy sources wherever practical and reasonable. This includes ensuring data centres supporting HPC in Australia are co-located near renewable energy sources. In addition, HPC facilities must have processes – and trained staff – to enable continuous improvement in making major pieces code more efficient. More efficient code takes less energy to run HPCD systems – a critical requirement to reduce power use. Finally, HPCD facilities should set, as part of use, minimum expectations on energy efficient code and provide a fee-for-service code improvement capability.

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Q14 - What are the priority NDRI investments in compute and AI that would enhance Australia's research efforts?

AI is a transformative tool that is already changing the scope, capability and nature of how research is done across several disciplines. To maximise this tool, Australian researchers need access to facilities – and skilled expert professional staff who can support them to develop and execute AI models and applications in appropriate and efficient ways for their research. To complement existing capabilities, Australia should also develop a targeted AI sovereign capability strategy that delivers on the HPC needs for AI and machine learning research, and also supports all researchers to access AI and machine learning capabilities.

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Aboriginal and Torres Strait Islander Peoples NDRI

Q15 - What investments are needed to make NDRI more culturally appropriate and aligned? Priority Reform 4 from the 2023 Closing the Gap Report highlights some key actions for Aboriginal and Torres Strait Islander Peoples Data.

This is a major area for focus and improvement in the research community; we as a community must do better in Indigenous research and in collaborations with Indigenous people and communities. However, the vast majority of 'investments' and actions needed are to do with the way research is undertaken and funded, and not NRI nor NDRI per se. For example, implementation of new data standards, ethical frameworks for managing data with Indigenous data sovereignty considerations and consent are research, researcher and institutional responsibilities. A key investment is the research community and institutions providing training to their staff and members on CARE/FAIR and in cultural competency, but this should not be a standard institutional professional development responsibility, rather than funded through NDRI. However, NDRI funding agreements and access agreements to NDRI/NCRIS capabilities can provide levers to incentives and drive this behaviour. NDRI agreements could include a requirement to identify culturally appropriate needs and any potential risks. Where there are high risks, facilities must ensure sufficient governance arrangements are in place. This could include a specific Board position for a First Nations person or First Nations advisory committee/s.

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Q16 - What NDRI investments would support Aboriginal and Torres Strait Islander Peoples knowledge systems?

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Q17 - What are the priority NDRI investments to support Aboriginal and Torres Strait Islander Peoples, including researchers, and enhance Australia's broader research efforts?

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Q18 - How can investments support the recent Australian Government's Framework for the Governance of Indigenous Data?

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Q19 - How can training, education and professional development be used to improve data in the Aboriginal and Torres Strait Islander Peoples NDRI space?

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Q20 - Is there a case for establishing a new NCRIS capability focused on supporting Aboriginal and Torres Strait Islander Peoples knowledge systems within the national research infrastructure system? If so, in what timeframe, and what preparatory and transition steps would you recommend?

It is not clear to STA what Indigenous-specific investments would be needed within NCRIS. AIATSIS and other GLAM facilities provide a foundational NRI capability in storing and managing Indigenous Knowledge systems. It is likely that a step change investment, similar to the Trove uplift, could be beneficial to ensure data repositories etc are improved for researcher specific needs. This would need to be explored through a comprehensive scoping study.

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NDRI Skills

Q21 - How can NDRI training, education and professional development for all NDRI users and operators account for ongoing and rapid advancements in NDRI, including digital capabilities not yet realised?

As research becomes increasingly digitised, researchers' and the NRI workforce training and professional development needs will increase. This will predominantly be discipline and/or facility specific. As such, there is no clear single thing that is 'NDRI training, education and professional development' that would be applicable across the entire sector. The vast amount of digital research skills are not the purview of NDRI and are the responsibility of institutions and researchers themselves. As NCRIS facilities are expected to uphold FAIR and CARE principles, best practice training would be useful. However, this is still not 'NDRI training'; it's advice and training in best research practice. FAIR and CARE are not NDRI-specific. NDRI could fund a consistent approach to such skills and training, but it's equally appropriate that this be research institutions' responsibility. Facilities must train staff with relevant skills. This includes an appropriate level of support for external users, i.e. access to trained experts in specific facilities/domains to support researchers e.g. trained staff to help users plan/execute AI models for their research or to optimise code to achieve maximum efficiency in HPC applications. This expertise is highly specific; there is no one investment that could meet this need. Facilities should include this in their budgets, with required costs being monitored to assess if an overall budget uplift for facilities to deliver adequate training is needed.

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Q22 - How can governments work with NDRI providers to address staff shortages and expand workforce training opportunities?

- **How can Australia attract and retain its NDRI workforce in a competitive global hiring market?**

Fundamentally, staffing arrangements are constrained by the employment contracts and enterprise agreements at the employing facility or institution, including how research/career metrics are applied. Improvements in career assessment should be informed by work of the Australian Chief Scientist in modernising research assessment. As such, there is no direct lever the Government can (or should) use to intervene beyond delivering appropriate co-investment to fund NCRIS facilities so they can offer competitive employment conditions. Setting competitive



remuneration levels and employment conditions to retain highly skilled and highly trained staff, especially in HPC and data-focussed facilities, is an ongoing challenge that is difficult to solve without significant uplift to staffing budgets (and possibly changes to enterprise agreements at employing institutions).

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Q23 - What are the priority NDRI skills investments that would enhance Australia's research efforts?

It would make more sense for the NCRIS team to consult with NCRIS projects to determine their levels of unmet training need to inform, then establish, a potential dedicated funding stream funding to support training programs at the various NCRIS facilities. However, whether this is the most effective use of limited NCRIS funding is debatable. One would assume that NCRIS facilities are already identifying necessarily staff training as part of their workplans and budgets.

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Software

Q24 - How can future NDRI investment support the various aspects of the research software lifecycle?

Funding for new research software packages should only attract Commonwealth Government funding if there is a clear and significant national need. Project level investments for software should not be a national priority.

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Q25 - How can future NDRI investments support researchers to achieve greater access to research software?

- **Reflect upon the principles of an open science agenda.**
- **When is it appropriate to purchase software vs. building our own?**

As NRI should be about national-scale investments and focus on collaboration investment it is not clear what use cases would justify off-the-shelf investments that would not be a cost shift from institutional or research project budgets. It would be useful for the Department to present examples of what is potentially envisaged.

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Q26 - Where do you see AI models fitting into software and national research infrastructure?

It is assumed that the question is in reference to new LLMs and MFMs. While there is merit in Australian-refined AI trained models and datasets the ROI for these are not clear given the significant cost required to build.

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Q27 - What are the priority NDRI investments to support Australia's research software engineering sector?

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Trust & Identity and Cybersecurity

Q28 - What measures are currently lacking or require improvement to enable Australia's researchers to conduct research in a safe and secure way, whilst protecting valuable digital resources?

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Q29 - How does Australia's future NDRI find a balance between enforcing trusted access and cybersecure measures whilst accommodating for open science principles and research with inherent risk?

- **Are there any international examples? Good, bad or ones which Australian researchers will have to adhere to as part of their international collaborations?**

The Australian Access Federation program is a good example of a system that enables researchers to access data held at multiple different institutions through a single log in authentication service. Existing for 12 years, this service facilitates safe and secure access across the research sector. This is a good example of national-level critical research infrastructure where the cost of its build and operation is appropriately funded by universities – an indication of its value proposition and utility. Just because something is NDRI does not mean it should be NCRIS or Government funded, and the same principle should apply to other infrastructure calls, even where there is wide need and utility. Commonwealth NDRI funding should not be used as a mechanism to cost shift support for high-value services – it must support a collaborative national community needs for high-cost NDRI that supports high-impact/value research.

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Q30 - What are the priority NDRI investments in trust and identity, and cybersecurity that would enhance Australia's research efforts?

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Final Question

Q31 - Is there any other information you wish to share with us regarding the NDRI Investment Plan?

The pace of change and increase in digitisation across all research domains is monumental. The funding available for NDRI is limited and as such, can not support every ask. There must be a firm



and clear definition – and threshold – for what constitutes NDRI. The definition outlined in the NDRI Strategy is vague and can be interpreted to encompass basically any piece of research infrastructure or dataset, especially when taken alongside the examples provided. There is an extremely high risk of NDRI funding attempting to support everything and everyone, with the end result of being spread so thin across the sector that nothing is adequately supported. All funding allocations must include a careful assessment of national need. Equally, NDRI should also not be synonymous with (or merely be seen as a sub-component of) NCRIS. There are several significant investments across Commonwealth agencies, including the PFRAs and also investments made by the Australian Bureau of Statistics on nationally important datasets. A whole of economy and whole of research system perspective is needed for planning and alignment. A truly comprehensive NDRI strategy and investment plan should seek to influence, leverage and (where possible) guide the investments outside the Department of Education/NCRIS. Given that this NDRI funding allocation is to include HPC (which was not allocated any funding in the most recent Investment Plan) this must be the primary focus. Australia’s Tier 1 HPC facilities, NCI and Pawsey urgently need funding to secure both base level operations as well as upgrades to meet Australia’s growing HPC needs – for both research and Government.

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