



Australian Government
Department of Education

NDRI Investment Plan Consultation Survey Summary

Software



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

- The software lifecycle, and its associated investment, needs to be thought of in terms of 3 kinds of software:
 - Investment in analysis tools should be focused on infrastructure to make them visible, findable and scalable.
 - Investment in prototype tools should focus on supporting people with the skills to re-engineer research software.
 - Investment in software infrastructure should focus on providing ongoing maintenance and a path to sustainability that goes further than that which is in scope for existing NCRIS infrastructures.
- Funding for policy development and definition of best practice in peer reviewing, design, maintenance, security, interface design.
- Investing in standards and frameworks that ensure software is interoperable and can work seamlessly across different platforms and systems.
- Establishing support services to assist researchers in using and troubleshooting software, including help desks and online resources.
- Developing sustainable funding models to support long-term software projects, ensuring they remain viable and useful over time.
- Encouraging the development and use of open-source software to promote collaboration and accessibility.
- Implementing guidelines and training for ethical and secure software development and usage, protecting data integrity and privacy.
- Assigning persistent identifiers (PIDs) to research software and platforms to monitor use/reuse and advocate for reward and recognition in peer-review systems.
- Incentivising institutions and funding bodies to acknowledge the substantial contribution made by research software and research software developers.
- Investing in a certification program for open-source research software that enforces best practices via peer review, such as the use of comprehensive tests and detailed documentation.
- Integrating newly developed research software with existing platforms, with trust and identity and cybersecurity incorporated throughout the development process (this is referred to as secure-by-design).
- Provisioning of high-quality open scientific software for data access, processing and AI/ML training to lower the cost of reproducibility.
- Software development and engineering:
 - Funding dedicated research software engineering teams, training/certification programs, and collaborative development platforms with version control and best practices.
- Preservation and archiving:
 - Establishing national/institutional software repositories, developing metadata standards for documentation, and investing in emulation/virtualization technologies for legacy software.



- Discoverability and reuse:
 - Creating centralised software registries, developing citation/attribution mechanisms aligned with academic incentives, and promoting open licensing models.
- Training and support:
 - Funding user support services, helpdesks, training workshops, for researchers/students, and fostering communities of practice.
- Performance and scalability:
 - Investing in higher performance compute (HPC) resources for computationally intensive applications, supporting parallel/distributed computing frameworks, and encouraging cloud/containerization technologies for scalable deployment.
- Investing in research software engineer fellowship programs.
- Creating clear career pathways that encourage talented young researchers to pursue research software development.
- Collaborating with the Research Software Engineers Australia and New Zealand (RSE-AUNZ) community to agree on guidelines for hiring or promoting researchers whose main role with research software is valuable to the research community but does not provide publications or make them competitive for funding.
- Funding registry creation to catalogue software that is in use with clear metadata, links to the source code with version control and licensing details. This will improve the reusability of software.
- Establishing source code repositories websites dedicated to research software applications and software infrastructure.
- Sponsoring annual software prize and reward categories.
- Strengthening collaboration and partnerships with international software or workflow development teams.
- Investing in HPC and cloud infrastructure for software development, automated testing, cloud-based deployment, long-term maintenance support, and promoting open-source software development.
- Investing in next-gen HPC infrastructure, co-located with user-centric national facilities (Tier-2), to support CPU- and GPU-intensive applications aligned with national strategic objectives, ensuring scalability and sustainability.
- Investing in a national research software incubator, to support the development of tools to capture and analyse Generative AI models and prompts which caters to the whole spectrum of social science disciplines.
- Encouraging collaborative projects across universities and facilities that bring together software developers and researchers from different disciplines.

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?**

- Establishing sustainable funding models to support the long-term maintenance and development of research software.
- Finding ways to encourage or incentivise open-source publishing of research software.
- Embracing the principles of open science by investing in open-source software development and ensuring that research software is freely accessible to the research community.
- A national initiative could be established to foster open-source development, akin to Europe's European Open Science Cloud (EOSC), providing collaborative platforms for sharing research software and data.
- Investing in interoperability standards to ensure that different software tools can work together seamlessly.
- Supporting training programs on open-source development, version control, and collaborative coding practices.
- Developing collaborative platforms that facilitate the sharing and co-development of research software.
- Supporting government agencies to develop ICT assessment and procurements pathways outside of the Business As Usual environment to enable rapid pilots of research and innovation interventions and infrastructure.
- Investing in cloud infrastructure that allows researchers to deploy research software without the need for local installations, especially for institutions without the technical infrastructure.
- In building software, it is important that NDRI investments leverage existing frameworks developed by the international community.
- Establishing open repositories for research software code, tools, and libraries, enabling discoverability and reuse across disciplines.
- Developing open licensing guidelines, clear documentation standards, and version control best practices for research software.
- Investing in cloud and containerisation technologies simplifying deployment and sharing of research software environments.
- Deploying a national research software catalogue that supports the description, categorisation and location of research software.
- Creating a “software use infrascopes” to identify software trends, support training programs, and assess the impact of software packages, enhancing research collaboration and funding opportunities.
- In considering buy or build, NDRI investment in software should identify areas of national strength where we wish to maintain capability, and areas where we wish to build up expertise as a competitive advantage.
 - **Regarding purchasing software:**
 - When there are existing, well-supported solutions that meet the research needs efficiently. This is often more cost-effective and timesaving than developing new software from scratch.
 - Software should in general not be purchased unless the associated terms guarantee easy access to all data, guarantee that the data will not be reused or sold by the software provider, and limit software telemetry.

- **Regarding building our own:**
 - When specific research requirements cannot be met by existing solutions, and when there is a need for highly specialised tools that align closely with the research objectives.
 - When commercial tools cannot keep pace with advancements in data generation or when specialised research areas are not of commercial interest. Custom solutions ensure adaptability, innovation, and alignment with the specific demands of cutting-edge research.

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

- AI models can play a crucial role in software and national research infrastructure by enhancing aspects of research and development by:
 - Integrating into data analysis tools to automate and accelerate the processing of large datasets, enabling researchers to derive insights more efficiently.
 - Supporting predictive analytics, helping to forecast trends and outcomes in various research fields.
 - Assisting in code generation, debugging, and optimisation, making the software development process faster and more reliable.
 - Enhancing the management and utilisation of high performance compute (HPC) resources, ensuring optimal performance and energy efficiency.
 - Supporting the creation of digital twins, which are virtual replicas of physical systems used for simulation and analysis.
 - Maintaining data security and integrity by detecting anomalies and potential threats in real-time.
 - Supporting fields facilitating complex simulations and data interpretations.
- AI models are a key component of software and national research infrastructure (NRI), but funding is not exclusively directed towards building AI models.
- Investments are needed, for example:
 - To support AI education, training programs, and nurturing a skilled workforce proficient in AI development, deployment, and integration with domain-specific research application.
 - To ensure ethical development, deployment, and governance of AI models within NRI, addressing concerns around bias, transparency, and responsible use.
 - To establish a national research software incubator, to support the development of tools to capture and analyse Generative AI models and prompts which caters to the whole spectrum of social science disciplines.
 - To establish a national library of open science AI models that can be leveraged by researchers on national AI infrastructure.
- Consideration should be given to how PIDs can be incorporated into AI models to gain insights into which models are most heavily used and to aid reproducibility.
- A national hub supported by NRIs can coordinate the training of AI models that requires significant investment and resources to test, adapt and deploy across several instruments and facilities.
- It would be more efficient to co-locate and maintain AI models with the data. Therefore, domain data repositories should be encouraged to host AI models alongside the datasets.
- AI tools are increasingly being used to support discovery of potential issues in large infrastructures such as HPCs however these should be used carefully as it has the potential to expose security issues to bad actors who can use it to exploit the system.

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

- Funding for long-term (ideally permanent) research software engineer roles, and investment in associated supporting policies, best practices, and cultural change across the research sector to support team-based research.
- Expanding the software developer merit allocation scheme as a cross-cutting national capability.
- Developing comprehensive training programs to build skills in software development, maintenance, and usage among researchers. This includes workshops, online courses, and certification programs.
- Establishing sustainable funding models to support long-term software projects, ensuring they remain viable and useful over time. This includes grants, fellowships, and partnerships with industry.
- Encouraging the development and use of open-source software to promote collaboration and accessibility. Provide resources and support for open-source projects.
- Investing in standards and frameworks that ensure software is interoperable and can work seamlessly across different platforms and systems. This enhances the usability and integration of various research software applications.
- Investing in robust computational resources, including high-performance computing systems equipped with advanced GPUs and specialised hardware.
- Investing in internship programs for new and emerging software engineers into NCRIS facilities would provide a good way of sharing skills and knowledge of software development best practice amongst NRI.
- Investing in establishing a national cross-NCRIS's Extreme-Scale Software Transformation program to support the transition to accelerate architectures and AI for modern research.
 - It will help build and nurture a national collaborative network of research software engineers with specialist skills in high-performance computing, extending existing expertise and capability of NCRIS facilities.
- Establishing national/institutional repositories and registries for research software, enabling discoverability, citation, and academic recognition.
- Investing in specific software capability in domains where Australia has a strong international track record and which will require ongoing software investment to stay at the forefront of international practice.
- Enhancing collaboration and partnerships with private sectors and promote closer collaboration with NDRI software engineers who can provide specialised support, including version control, cybersecurity, and permissions management.
- Fostering international collaborations by strengthening partnerships with global software and workflow engineering/development teams to facilitate co-design and co-development of software tailored for Australian specific research (where required).
- New investments need to leverage and build upon existing NCRIS investments already in place.
 - This will increase sustainability and support of software in use in the sector.
 - It will reduce poor investments in bespoke solutions and ensure a consistent approach.

- Supporting the research software engineers in RSE-AUNZ association to help engage the grassroots community, across domains and across states.
- Co-locating research software development teams:
 - There is no explicit program for embedding research software engineer teams on-site at large research facilities.