Australian Government

Department of Innovation, Industry, Science and Research

National Collaborative Research Infrastructure Strategy

Evaluation Report

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Glossary

AAHL - Australian Animal Health Laboratory

AAL - Astronomy Australia Limited

AAT - Anglo-Australian Telescope

ABF - Australian Bioinformatics Facility

ABIN - Australian Biosecurity Intelligence Network

ACBRF - AAHL Collaborative Biosecurity Research Facility

ACG - Australian Commonwealth Grant

AeRIC - Australian eResearch Infrastructure Council

AGRF - Australian Genome Research Facility

ALA - Atlas of Living Australia

AMMRF - Australian Microscopy and Microanalysis Research Facility

ANDS - Australian National Data Service

ANFF - Australian National Fabrication Facility

ANSTO - Australian Nuclear Science and Technology Organisation

APN - Australian Phenomics Network

APPF - Australian Plant Phenomics Facility

ARC - Australian Research Council

ARCS - Australian Research Collaboration Service

ASRP - Australian Synchrotron Research Program

BPA - Bioplatforms Australia

CSIRO - Commonwealth Scientific and Industrial Research Organisation

CRC - Cooperative Research Centre

DEST - Department of Education, Science and Training

DIISR - Department of Innovation, Industry, Science and Research

EIF - Education Investment Fund

EIF/SSI - Education Investment Fund/Super Science Initiative

EMBL - European Molecular Biology Laboratory

GA - Genomics Australia

GMT - Giant Magellan Telescope

HEEF - Higher Education Endowment Fund

ICT - Information and Communications Technologies

IMOS - Integrated Marine Observing System

ISAP - International Synchrotron Access Program

KPI - Key Performance Indicator

LIEF - Linkage Infrastructure, Equipment and Facilities

MA - Metabolomics Australia

MNRF - Major National Research Facilities

NCRIS - National Collaborative Research Infrastructure Strategy

NDF - National Deuteration Facility

NeAT - National eResearch Architecture Taskforce

NIF - National Imaging Facility

NIS Review - National Innovation System Review

NMHRC - National Health and Medical Research Council

NRIC - National Research Infrastructure Council

NRIT - National Research Infrastructure Taskforce

OHS - Occupational Health and Safety

OPAL reactor - Open Pool Australian Lightwater reactor

PfC - Platforms for Collaboration

PHRN - Population Health Research Network

PMSEIC - Prime Minister’s Science, Engineering and Innovation Council

RRDC - Rural Research and Development Corporation

RIBG - Research Infrastructure Block Grants

RISS - Research Infrastructure Support Services

SII - Systemic Infrastructure Initiative

SRE - Sustainable Research Excellence

TERN - Terrestrial Ecosystem Research Network

Executive Summary

The National Collaborative Research Infrastructure Strategy (NCRIS) is an Australian Government program for the development of national research infrastructure that has provided $542 million from 2005-06 through to 2010-11. The aim of the program is to provide researchers with access to major research facilities and the supporting infrastructure and networks necessary to undertake world-class research.

Key features of NCRIS — namely the emphasis on collaboration from the outset, the strategic identification of capabilities through the consultative roadmapping process, the facilitation process to develop capability plans and the provision of funding for skilled staff and operating costs — contribute to the NCRIS model being an appropriate, effective and efficient mechanism for establishing critical research infrastructure for Australia. Incorporation of these key features should be considered in the development of policy for future research infrastructure programs.

There are some key learnings arising from this evaluation with respect to facilitation, governance, interactions with state and territory governments and the source of funding within the system for infrastructure access. These are elements requiring further consideration in the design of programs for research infrastructure provision going forward.

Current uncertainty about future funding for research infrastructure, particularly the provision of funding for operating costs and specialist staff, creates management difficulties for current NCRIS capabilities and places Australia at risk of losing the highly-skilled work-force required for efficient operation of sophisticated facilities. This issue should also be considered for future funding programs.

In the preparation of this NCRIS Evaluation Report the Evaluation Team, convened by the Department of Innovation, Industry, Science and Research, drew on the work of a Science Panel and an Economic Consultant. The teams developed their assessment of the NCRIS program using evidence gained from a stakeholder survey and from consultations with NCRIS capability providers, users and key stakeholders including state and territory governments, universities and publicly funded research agencies. Key findings relating to the terms of reference are summarised as follows.

Appropriateness

There is a clear, ongoing need for government funding of research infrastructure. It is appropriate, and consistent with current government policy, that government provide funding to create research infrastructure to enhance the national innovation system and to foster collaboration.

The roadmapping process that underpinned decision-making in the implementation of the NCRIS program provided a firm foundation for the allocation of funding. The

systematic and consultative approach to resource allocation ensured that the highest national priority capabilities were addressed. With appropriate, regular updates, this process is recommended for future research infrastructure funding programs.

Facilitation achieved effective resource allocation within capabilities and is an appropriate mechanism for developing national capabilities.

The choice of facilitator is critical to the success of a facilitation process. The balance between the need for an independent facilitator and the need for the facilitator to have standing in, and knowledge of, the relevant community requires careful consideration.

Collaboration naturally drives a broader perspective and is good for resource allocation within a capability.

The NCRIS model is appropriate for funding medium- to large-scale, capability-based research infrastructure and, for this type of infrastructure, is superior to previous models. The analysis shows that it has substantially improved the allocation of resources.

Effectiveness

The NCRIS approach has been successful in achieving the creation of improved national research capability by embracing a broad definition of infrastructure to develop new facilities and leverage existing capacity.

The NCRIS program has broad community support and has engendered a trend towards a more strategic and collaborative approach to the funding and development of research infrastructure.

NCRIS capabilities are supporting novel, collaborative research activities that are already, or have the potential to be, world-class.

The NCRIS program is cost-effective. Particular outcomes that contribute to its cost-effectiveness are:

- a willingness to invest in human capital and operating costs, resulting in superior service delivery and viability of facilities;
- combined bargaining power resulting in improved pricing; and
- leveraging of existing infrastructure and co-investment, resulting in investments of increased value.

There is clear evidence the NCRIS program has been effective in meeting research infrastructure needs within the defined funding envelope. Whether this effect continues to be achieved will depend on whether the momentum gained by NCRIS can be maintained.

Efficiency

Taking into account government reporting requirements, administration of the NCRIS program by the department has been efficient, with all funds contracted on schedule and with appropriate administrative costs for a complex program.

Future programs for funding research infrastructure should consider providing more advice and guidance regarding suitable governance models.

Greater transparency is needed around how access fees for infrastructure are charged, including improved rigour and documentation regarding the calculation and degree to which access fees reflect true marginal costs.

Access to research infrastructure needs to be paid for somewhere in the innovation system. Currently it is unclear where this responsibility lies. This issue should be addressed.

Integration

NCRIS appears to have been successful in engaging Australian Government, state and territory governments and government agencies on priority areas without compromising a national approach to funding research infrastructure.

Performance Assessment

Performance assessment for NCRIS capabilities is adequate, but could be improved by more consistent and benchmarked performance indicators across capabilities, and aggregation of performance data online.

Strategic Policy Alignment

NCRIS is aligned with the Australian Government’s broader policy objectives and with its programs. Future research infrastructure funding programs would need to ensure that this alignment is retained for existing and new programs.

Introduction

The National Collaborative Research Infrastructure Strategy (NCRIS) is an Australian Government program for the development of national research infrastructure. The program was announced in the May 2004 Budget, with a total of $542 million allocated for investment from 2005-06 through to 2010-11 to provide researchers with access to major research facilities and the supporting infrastructure and networks necessary to undertake world-class research.

Evaluation of NCRIS

It is an Australian Government requirement that all terminating programs be evaluated. An evaluation strategy for the NCRIS program was developed in 2006. This strategy recommended an evaluation of the program be conducted in 2009, prior to the conclusion of current program funding.

In 2009 the Department of Industry, Innovation, Science and Research (DIISR; also referred to as the department) commenced planning for evaluation of the NCRIS program in accordance with the expenditure review principles established by the Department of Finance and Deregulation. This evaluation examines the standard evaluation criteria of appropriateness, efficiency, effectiveness, integration and performance assessment. Terms of Reference for the evaluation were agreed by the DIISR Executive Committee in April 2009 and are provided at **Appendix A**.

The basic question addressed in this evaluation is the extent to which the NCRIS model — i.e. the approach, design and implementation of the program — has been appropriate, effective and efficient in establishing research infrastructure for Australia. An important component of this is to examine whether the NCRIS model itself has added value apart from the direct fiscal impact of the funds invested. In so doing, comparisons between NCRIS and other mechanisms for funding research infrastructure have been made.

Evaluation methodology

In April 2009 the department established an Evaluation Team to undertake an evaluation of the NCRIS program. The members of this team are listed in **Appendix B**. The Team was tasked with responsibility for ensuring that the NCRIS Evaluation Terms of Reference were addressed and that appropriate methodologies were used to gather evidence and draw the conclusions described in this report.

The Evaluation Team appointed an expert Science and Research Panel (referred to as the Science Panel) and an Economic Consultant to provide assistance with the Evaluation by contributing specific areas of expertise and through the provision of analysis of various aspects of the NCRIS program. Terms of Reference for the

Science Panel and Economic Consultant are also provided at **Appendix A** and membership details at **Appendix B**.

The Evaluation Team, with the assistance of the Science Panel and Economic Consultant, developed their assessment of the NCRIS program. This used evidence gained from a stakeholder survey conducted by the department and from consultations with NCRIS capability[1] providers, users[2] and key stakeholders including state and territory governments, universities and publicly funded research agencies.

The Review of the National Innovation System (Venturous Australia – building strength through innovation) [3] recommended funding for a successor program to the NCRIS program. The Evaluation Team has therefore also considered evidence for the grounds on which further funding for research infrastructure can be sought, to inform the development of future policy for research infrastructure programs.

Background to research infrastructure in Australia

It is widely accepted that investment in innovation, including research, drives productivity, and that excellent research infrastructure is necessary to facilitate the delivery of high-quality scientific research [4]. It is important to ensure that the approach used to plan, fund and develop research infrastructure delivers the maximum scientific outcome for the nation, for the money invested.

Definition of research infrastructure

A definition of research infrastructure, as stated in the final report of the National Research Infrastructure Taskforce (NRIT), released in 2004 is:

> 'Research infrastructure comprises the assets, facilities and services, which support organised research across the innovation cycle and which maintain capacity of researchers to undertake organised research. It excludes academic personnel directly responsible for research and the direct cost of their research (such as, travel and consumables)[5]'

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[1] NCRIS capabilities are first described in detail in the 2006 Strategic Roadmap. DEST, 2006.
[2] In the context of this report, "users" are users of NCRIS research infrastructure facilities.
[3] See recommendation 6.14 in DIISR, 2008. Venturous Australia – building strength in innovation.
[4] See Overview p xvii in Productivity Commission, 2007. *Public Support for Science and Innovation.*
OECD, 2007. *Innovation and Growth Rationale for an Innovation Strategy.*; and
p ix in DEST, 2004. *The Final Report of the National Research Infrastructure Taskforce*.
[5] DEST, 2004. *The Final Report of the National Research Infrastructure Taskforce.*

The final NRIT report also concluded that:

> 'To ensure that research infrastructure investments continue to be productive, relevant and viable, the Taskforce concludes that ... the best option is to fund not only the capital cost of the infrastructure, but also the standing operating costs.'

Investment in research infrastructure is an essential input to the delivery of excellent research. Research infrastructure is a vital subset of the resources that support researchers [6].

In this sense, research infrastructure includes more than just physical assets, and extends to enabling infrastructure such as data streams, information and communication technologies (ICT) and skilled support staff who maintain and operate research facilities. Some infrastructure investments involve providing Australian researchers with access to major research facilities located overseas. International collaboration of this sort helps to link Australian researchers more strongly with the global research community. Correspondingly, investments in national research infrastructure can contribute to building world-class facilities that are attractive to overseas researchers.

Research infrastructure can be categorised according to a range of factors including cost, complexity and the extent of collaboration required. For example, at the institutional level, investments in research infrastructure are generally site-specific in nature and may mostly be used by local researchers or their collaborative partners.

It also needs to be recognised that infrastructure is often not exclusively research-focused. In many areas, the infrastructure may have a complementary function for other purposes, such as supporting operational uses and applications.

Previous research infrastructure programs

In 2003 the Taskforce on Mapping Australian Science and Innovation prepared a background paper on research infrastructure[7]. This document provides an overview of the state of research infrastructure in Australia at the time and the main funding mechanisms available for the establishment and support of this infrastructure. It listed the major programs of the Australian Government as:

- the Major National Research Facilities (MNRF) program;
- the Higher Education Systemic Infrastructure Initiative (SII);

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[6] DIISR, 2008. Strategic Roadmap for Australian Research Infrastructure

[7] DEST, 2003. Research Infrastructure. Mapping Australian Science and Innovation Background Paper.

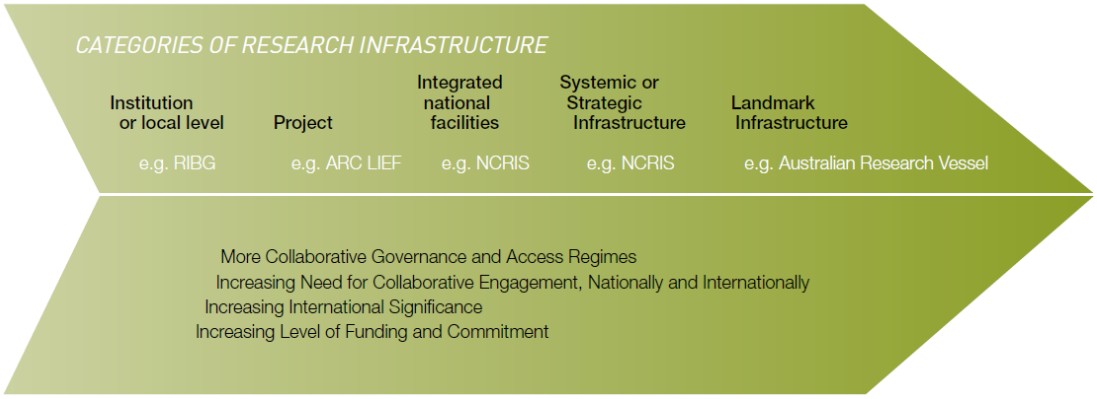
- the Research Infrastructure Block Grants (RIBG) Scheme; and
- the Australian Research Council Linkage Infrastructure, Equipment and Facilities (ARC LIEF) program.

The paper also noted that, outside of these major programs, there were several ways in which the Australian Government funds infrastructure, including the National Health and Medical Research Council (NHMRC), Cooperative Research Centres (CRCs) and centres of excellence.

Current funding for research infrastructure

While there is some overlap in the application of the above programs to particular types of research infrastructure, in general these programs address different needs and have different characteristics. The *Strategic Roadmap for Australian Research Infrastructure* released in 2008 (referred to as the 2008 Roadmap) described the categories of research infrastructure and relevant funding programs. The 2008 Roadmap noted that NCRIS supports national, strategic and systemic research infrastructure that is of larger scale than institutional or project infrastructure, but does not include large-scale 'landmark' infrastructure. This research infrastructure continuum is illustrated in **Figure 1**.

Figure 1 Categories of research infrastructure funding programs



Since the release of the Mapping Australian Science and Innovation report in 2003, the MNRF and SII programs have been discontinued. Currently, in addition to the NCRIS program, the Australian Government is providing funding and support for research infrastructure through the following initiatives:

- Education Investment Fund (EIF) competitive rounds;
- the Super Science Initiative (SSI);
- the ARC LIEF program;

- NHMRC Infrastructure Grants. Three types of grants are available: enabling, equipment, and independent magnetic resonance imaging (MRI) infrastructure support;
- the Research Infrastructure Block Grants (RIBG) Scheme; and
- the Sustainable Research Excellence in Universities (SRE) initiative.

The Australian Government is not the only government in Australia investing in research infrastructure. State governments also have several programs to support and fund the development of research infrastructure.

For the most part, NCRIS operates in a different space from other infrastructure programs, and thus complements them and does not duplicate or impede their efforts. For example, NCRIS is primarily focused on the development and creation of infrastructure, as opposed to the RIBG Scheme, which focuses on the indirect costs associated with Australian Competitive Grants (ACGs). NCRIS typically funds infrastructure projects of a larger scale than those funded under NHMRC Infrastructure Grants, ARC LIEF and most state government programs. The research infrastructure projects that have been funded through the Super Science Initiative were informed by the 2008 Roadmap, and several of these projects build on capabilities funded under the NCRIS program. This has ensured a degree of continuity between the two programs.

Development of the NCRIS Program

The NCRIS program was the result of a process of policy development for research infrastructure that involved national consultation and input from a range of stakeholders over several years. Key developments are discussed in subsequent sections. Table 1 provides an overview of the history and development of the NCRIS program.

Table 1 NCRIS Development[8]

Timeframe	Body	Actions
July 2003 – March 2004	National Research Infrastructure Taskforce	Released National Research Infrastructure Taskforce Report
May 2004	Australian Government	Announced National Collaborative Research Infrastructure Strategy (NCRIS)
October 2004 – July	NCRIS Advisory Committee	Undertook first national consultations Released Draft Implementation

[8] Blue text denotes hyperlinks in electronic version

2005		Framework Released Capability Scoping Document Released Implementation Advice July 2005
September 2005 – May 2009	NCRIS Committee	Released Exposure Draft of 2006 NCRIS Strategic Roadmap Undertook second national consultations Released 2006 NCRIS Strategic Roadmap (February 2006) Released NCRIS Investment Framework (April 2006) Appointed facilitators and guided development of investment plans for NCRIS capabilities Approved investment plans
September 2005 - January 2006	NCRIS Expert Subcommittees	Worked with NCRIS Committee to create Exposure Draft of 2006 NCRIS Strategic Roadmap
March 2006 – September 2008	Capability Facilitators	Worked with capability areas to create draft investment plans
November 2006 – ongoing	Capabilities	Funding Agreements signed and Projects being implemented
April 2007	NCRIS Secretariat	Released Review of NCRIS Roadmapping and Facilitation Processes
April 2008	NCRIS Committee	NCRIS Committee Submission to the Review of the National Innovation System
April 2008	Australian eResearch Infrastructure Council (AeRIC)	Submission to the Review of the National Innovation System Closing the Gap - Connecting Researchers to the Innovation System through Sustained Investments in Collaborative Research Infrastructure
March 2008 - July 2008	2008 Expert Working Groups	Worked with NCRIS Committee to create Exposure Draft of the 2008 Strategic Roadmap for Australian Research Infrastructure
March 2008 -	NCRIS Committee	2008 Strategic Roadmap for Australian

September 2008		Research Infrastructure, released by Minister for Innovation, Industry, Science and Research
September 2009	NCRIS Secretariat	Released NCRIS Investment Framework v.2

National Research Infrastructure Taskforce

The need for a more strategic approach to providing the high-quality infrastructure necessary for world-class research was identified in 2000 in the Chief Scientist of Australia's discussion paper *The Chance to Change*[9] and in the final report of the Innovation Summit Implementation Group, *Innovation: Unlocking the Future*[10]. In May 2003, as part of the *Our Universities: Backing Australia's Future* policy, the Australian Government announced that it would establish a taskforce to develop a nationally integrated research infrastructure strategy to apply to public higher education institutions and publicly funded research agencies. In August 2003 the Australian Government established the National Research Infrastructure Taskforce (NRIT).

NRIT was charged with undertaking a review of research infrastructure funding and making recommendations to the Australian Government regarding an appropriate model for the future. NRIT consulted the Australian research community and sought submissions on a discussion paper and exposure draft of a strategy for future development of research infrastructure.

In its final report[11], released in March 2004, NRIT recommended a set of principles and a national process to identify, prioritise and fund research infrastructure needs. One of the key findings of the NRIT report was that Australia needed to strengthen, plan and prioritise research infrastructure. NRIT recommended that a successor program to the Australian Government's Systemic Infrastructure Initiative (SII) and Major National Research Facilities (MNRF) program be established under the guidance of a National Research Infrastructure Council.

Announcement of NCRIS

In responding to the NRIT report, the Australian Government announced the National Collaborative Research Infrastructure Strategy (NCRIS) in the 2004-05 Budget as part of the Backing Australia's Ability: Building Our Future through Science and Innovation package.

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[9] Batterham, R., and DIISR, 2000. *The Chance to Change Discussion Paper* by the Chief Scientist.

[10] Innovation Summit Implementation Group, 2000. *Innovation: Unlocking the Future*.

[11] DIISR, 2004. *The Final Report of the National Research Infrastructure Taskforce*.

In announcing NCRIS, the government stated its intention that the program would:

- embrace a new, strategic approach to funding research infrastructure intended to link infrastructure to Australia's National Research Priorities;
- encourage greater collaboration in research and in the development of research infrastructure;
- establish priorities for government investment in world class research facilities, networks and infrastructure;
- be driven by principles to allow a focus on outcomes and to accommodate and value the diversity of the research infrastructure landscape; and
- incorporate a process of consultation in the development of the mechanisms for establishing priorities and investment strategies.

NCRIS Advisory Committee

In October 2004 the Australian Government appointed an NCRIS Advisory Committee to provide advice on the funding principles to be employed and the process to be followed for implementing the national infrastructure strategy. The membership of the Advisory Committee is given in **Appendix C**.

In relation to NCRIS, the Advisory Committee:

- provided guidance on areas in which investments in research infrastructure would significantly enhance the capacity of the national research and innovation system in delivering national benefits;
- advised on the principles and mechanisms that could apply in identifying and funding specific investment priorities; and
- advised on the establishment of the NCRIS Committee to manage the long-term implementation, monitoring and review of NCRIS.

The Advisory Committee released a *Draft Implementation Framework* paper in November 2004 and then undertook national consultations in late November and December of 2004 in all national capitals to meet with stakeholders and form a complete picture of the requirements for Australian research infrastructure funding over the NCRIS funding period.

As part of this initial round of public consultation, a list of major items of research infrastructure was compiled in 2005[12].

[12] DEST, 2005. *List of Major Australian Research Infrastructure.*

In May 2005 the Advisory Committee released a capability scoping document summarising the capabilities proposed for a 'strategic roadmap' of Australia's research infrastructure needs. Also in May 2005 an expert forum was held to help scope the 2006 NCRIS Strategic Roadmap and provide a strategic overview of needs. Participants were invited from the Learned Academies, funding and research agencies, and professional associations.

In July 2005 the Advisory Committee released their Implementation Advice[13] for the next stage of NCRIS. This advice was endorsed by the then Minister for Education, Science and Training, and the Advisory Committee was wound up.

NCRIS Committee

In response to the recommendations of the NCRIS Advisory Committee, the NCRIS Committee was established in September 2005 to continue the development of the NCRIS Strategic Roadmap and the implementation of the program. The NCRIS Committee was tasked with responsibility for advising the Australian Government on a national strategy for the development of research infrastructure and establishing priorities for investment. The membership and terms of reference of the NCRIS Committee and a summary of the NCRIS Committee deliberations are given in **Appendix D**.

The 2006 NCRIS Strategic Roadmap

In order to assist with the development of the *National Collaborative Research Infrastructure Strategy Strategic Roadmap*[14] (referred to as the 2006 NCRIS Strategic Roadmap) and to canvass community views regarding priorities for investment in research infrastructure, the NCRIS Committee established four expert subcommittees. The subcommittees aligned with Australia's four National Research Priorities:

- an Environmentally Sustainable Australia;
- Promoting and Maintaining Good Health;
- Frontier Technologies; and
- Safeguarding Australia.

In developing the 2006 NCRIS Strategic Roadmap, the NCRIS Committee focused its attention on developing national *capability* through infrastructure investment rather than focusing investment on individual discipline needs. The rationale for focusing on

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[13] DEST, 2005. *National Collaborative Research Infrastructure Strategy (NCRIS) Advisory Committee Implementation Advice.*
[14] DEST, 2006. *National Collaborative Research Infrastructure Strategy Strategic Roadmap.*

the development of national research capability was the view that this would drive a more strategic perspective in Australian science as a whole and provide more efficient and complete use of the infrastructure. The capability focus was also intended to help drive effective collaboration in solving complex, multidisciplinary problems.

The NCRIS Committee took the view that, historically, the approach to funding research infrastructure in Australia had been relatively ad hoc and over the years there had been little continuity in the funding programs[15]. Furthermore, the programs had typically been competitive. The NCRIS Committee felt that the consequence was that the science community had been opportunistic and had taken a 'silo' approach to its research and research infrastructure investment[16]. The result was overlap, duplication, and a less than optimal use of the available funds. Starting with the 2006 NCRIS Strategic Roadmap, the NCRIS program attempted to drive a strategic perspective through the research community in regard to infrastructure investment. Significant funding over a relatively long time frame was allocated to the program so that it was possible to start this process.

In the implementation of this strategic perspective, the NCRIS Committee determined which capabilities were priorities for NCRIS funding. Limiting the number of capabilities was intended to allow each to have sufficient funding to have a systemic, national impact. The Committee also attempted to ensure, via the facilitation process, that funds were sufficiently concentrated within each capability to have the desired systemic impact. This approach was adopted with the aim of avoiding the funding being invested sub-optimally.

An exposure draft of the strategic roadmap was released in November 2005 and, following stakeholder input, the final roadmap was released in February 2006. The 2006 NCRIS Strategic Roadmap presented a high-level strategic view of the infrastructure needs of the Australian research science community as a whole. An important element of the 2006 NCRIS Strategic Roadmap was the identification of a key set of principles, reflecting the advice of the NCRIS Advisory Committee, to underpin the design and implementation of the NCRIS program. The NCRIS Principles are presented in **Box 1**.

Investment planning for NCRIS capabilities

The 2006 NCRIS Strategic Roadmap identified sixteen priority capabilities for medium- to large-scale research infrastructure investment over the following ten

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[15] p 7, p11 in DIISR, 2004. *The Final Report of the National Research Infrastructure Taskforce*..

[16] p 22, p 25 in DEST, 2003. *Research Infrastructure. Mapping Australian Science and Innovation Background Paper.*

years. These capabilities are listed in **Box 2**. The roadmap identified nine capabilities as being ready for immediate investment, two further capabilities as requiring more scoping prior to investment, and four capabilities identified to be progressed at a later stage. Planning for the underpinning capability Platforms for Collaboration (see **Case Study 1**) was deferred until investment planning for the other eight funded capabilities was well advanced.

Following the release of the 2006 NCRIS Strategic Roadmap, the NCRIS Committee commenced a process for the development of investment plans for the first nine priority capabilities identified in the roadmap as being ready for investment. The NCRIS Committee appointed facilitators to assist in the development of these investment plans. Further discussion on the role of facilitators is provided below as one of the distinctive features of NCRIS.

Investment Framework

Building on and complementing the NCRIS Principles contained in the 2006 NCRIS Strategic Roadmap, the NCRIS Committee released an *Investment Framework* [17] in April 2006 to guide facilitators and the relevant research communities in the development of investment plans. A revised Investment Framework was released in September 2009[18].

Announcement of NCRIS investments

Following assessment of investment plans for the first nine capabilities, the NCRIS Committee recommended funding for these nine capabilities to the then Minister for Education, Science and Training, and further recommended that funding be set aside for the two capabilities that were still being scoped. This funding was approved by the then Minister and announced in November 2006.

Further scoping was performed for investment in an information network under the Networked biosecurity framework capability and the development of investment plans for the two remaining capabilities was also commenced. Development of the investment plan for Platforms for Collaboration was completed and negotiation of funding agreements for the implementation of the first nine capability projects was then undertaken. A brief description of each capability, together with an overview of the funding provided, is given in **Appendix E**.

Box 1 – NCRIS Principles[19]

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[17] DEST, 2006. *Investment Framework.*

[18] DIISR, 2009. *Investment Framework v2*.

[19] Box 1 is presented as text in this Word version for accessibility reasons. It is presented as a box in the PDF version.

- Australia's investment in research infrastructure should be planned and developed with the aim of maximising the contributions of the R&D system to economic development, national security, social wellbeing and environmental sustainability.
- Infrastructure resources should be focussed in areas where Australia is, or has the potential to be, world-class (in both discovery and application-driven research) and can provide international leadership.
- Major infrastructure should be developed on a collaborative, national, non-exclusive basis. Infrastructure funded through NCRIS should serve the research and innovation system broadly, not just the host/funded institutions. Funding and eligibility rules should encourage collaboration and co-investment. It should not be the function of NCRIS to support institutional level (or even small-scale collaborative) infrastructure.
- Access is a critical issue in the drive to optimise Australia's research infrastructure. In terms of NCRIS funding there should be as few barriers as possible to accessing major infrastructure for those undertaking meritorious research.
- Due regard should be given to the whole-of-life costs of major infrastructure, with funding available for operational costs where appropriate.
- The Strategy should seek to enable the fuller participation of Australian researchers in the international research system.

Box 2 - NCRIS Capabilities identified in 2006 NCRIS Strategic Roadmap[20]

5.1 Evolving bio-molecular platforms and informatics[a]

5.2 Integrated biological systems[a]

5.3 Characterisation[a]

5.4 Fabrication[a]

5.5 Biotechnology products[a]

5.6 Translating health discovery to clinical application[c]

5.7 Population health and clinical data linkage[b]

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[20] Box 2 is presented as text in this Word version for accessibility reasons. It is presented as a box in the PDF version.

5.8 Networked biosecurity framework[a]

5.9 Heavy ion accelerators[c]

5.10 Optical and radio astronomy[a]

5.11 Terrestrial ecosystem research network[b]

5.12 Integrated marine observing system[a]

5.13 Structure and evolution of the Australian continent[a]

5.14 Low-emission, large-scale energy processes[c]

5.15 Next generation solutions to counter crime and terrorism[c]

5.16 Platforms for Collaboration[a]

Key

a. Capabilities identified in the 2006 Strategic Roadmap as being ready for immediate investment plan development

b. Capabilities requiring further scoping prior to investment plan development

c. Capabilities to be progressed at a later stage.

Case Study 1. Platforms for Collaboration

The NCRIS Committee recognised that effective use of information and communications technologies (ICT) would be critical to the success of many of the capabilities. They felt that it was important to facilitate and support the emergence of entirely new fields of research by making it possible for researchers to collect, move and manipulate large amounts of data and to interact with these data through sophisticated software tools. Provision of data- and tool-rich discovery environments enables the addressing of complex problems while the infrastructure technologies themselves create new and previously inaccessible avenues for research activities.

The NCRIS Committee was of the view that the different capabilities would be facing a common set of issues in achieving these outcomes, and that it would not be efficient for each of the capabilities to solve those issues in isolation. Thus Platforms for Collaboration (PfC) was created as an underpinning capability to address the common issues, create a strong, coherent support infrastructure across all the other capabilities, and facilitate sharing of solutions.

In order to understand what the PfC capability needed to deliver, it was necessary to have the other funded capabilities underway so that it was possible to identify the common issues.

The PfC capability delivers its support to the other capabilities through five components:

- the National Computational Infrastructure (NCI), delivering internationally significant high-performance computing (HPC) capability and providing a national strategy for computation infrastructure;
- the Interoperation and Collaboration Infrastructure (ICI), providing grid-enabled technologies and infrastructure to enable seamless access to research facilities and services;
- the Australian National Data Service (ANDS), enabling researchers to identify, locate, access and analyse any available research data;
- the Australian eResearch Infrastructure Council (AeRIC), providing the governance and coordination body within the PfC capability; and
- the National eResearch Architecture Taskforce (NeAT), providing guidance on the evolution of the national eResearch infrastructure.

Review of NCRIS Roadmap and facilitation processes

In 2007 the NCRIS Committee commissioned a review of the early implementation phase of the NCRIS program, including the development of the 2006 NCRIS Strategic Roadmap and the facilitation processes. This review was based on:

- public submissions in response to the initial exposure draft of the 2006 NCRIS Strategic Roadmap;
- reports by facilitators following the development of the investment plans for the first nine capabilities; and
- stakeholder responses to a survey, conducted by the NCRIS Secretariat in February-March 2007.

A report based on this preliminary review was released in April 2007[21]. The overall conclusions from this review were, considering the current stage in the implementation of NCRIS, that there was a widespread view among stakeholders that the national, collaborative approach to the allocation of infrastructure funding should be supported as it has the potential to provide wider access to better infrastructure. There was strong support from stakeholders for the NCRIS approach to allocating research infrastructure funds. There was wide agreement that taking a national, collaborative approach to infrastructure investment has the potential to

[21] DEST, 2007. *Review of NCRIS Roadmap and Facilitation Processes*.

realise economies of scale and that appropriate access and pricing regimes can result in effective use of the investment.

To a large degree, stakeholders considered that the roadmap and investment plans did identify the appropriate, high-priority research infrastructure investments. It was noted, though, that the roadmap reflected views at a particular point in time and would need updating in the future.

2008 Strategic Roadmap for Australian Research Infrastructure

In March 2008 a review of the 2006 NCRIS Strategic Roadmap was commenced in order to update the priorities for ongoing investment in research infrastructure[22]. It was intended that the review should re-examine the capabilities identified in the 2006 NCRIS Strategic Roadmap to determine if they were still national priorities, and identify new priority capabilities for potential investment.

The *Strategic Roadmap for Australian Research Infrastructure*[23] (the 2008 Roadmap) was released by the Minister for Innovation, Industry, Science and Research on 4 September 2008. This roadmap reaffirmed that the twelve capabilities funded under NCRIS continued to represent priority areas for investment. It also identified two new capability areas; Humanities, Arts and Social Sciences, and Built Environment.

Powering Ideas – An Innovation Agenda for the 21st Century

In May 2009 the Australian Government released *Powering Ideas – An Innovation Agenda for the 21st Century*[24] (referred to as *Powering Ideas*). A significant component of Powering Ideas was the announcement of $901 million for research infrastructure as part of the Super Science Initiative, targeting key priorities identified in the *Review of the National Innovation System* and the 2008 Roadmap.

The establishment of a National Research Infrastructure Council (NRIC), to provide strategic advice on future research infrastructure investments including those to be funded through the Super Science Initiative, was also announced in *Powering Ideas*. As part of its responsibilities, the NRIC assumed oversight of the NCRIS program and the NCRIS Committee was dissolved in 2009.

Distinctive features of NCRIS

[22] Working groups were convened to assist with the community consultation process.
[23] DIISR, 2008. *Strategic Roadmap for Australian Research Infrastructure*.
[24] DIISR, 2009. *Powering Ideas: an innovation agenda for the 21st century.*

NCRIS introduced significant changes in the approach to prioritising, planning and investing in research infrastructure compared with previous research infrastructure funding programs.

The stated objectives of the NCRIS program were:

- to provide major research infrastructure that is national and strategic, collaborative, and world-class;
- to promote a sustained cultural shift towards investment attitudes that are national and strategic, and collaborative; and
- to foster research activity that is collaborative and world-class.

In order to achieve these objectives and to implement the intentions of the program as encapsulated in the NCRIS principles (see **Box 1**), several distinctive approaches were taken in the design and implementation of the program, as outlined below.

Strategic identification of capabilities

As discussed in above, a strategic approach to the provision of research infrastructure was adopted under the NCRIS program to avoid unnecessary, overprovided or duplicated infrastructure, and to minimise gaps in infrastructure delivery. Further, as a moderate-sized participant in the international research arena, it was assumed that Australia cannot be competitive in all fields of research, nor can it afford all elements of research infrastructure that researchers might wish to utilise. The NCRIS Committee sought to identify the capability areas that were national priorities and should be considered for funding, and then directed funding to projects within those capabilities to maximise the scientific outcomes.

The NCRIS Committee determined that this strategic approach also offers Australia the best prospect of its researchers participating in world-class research endeavours, whether in common, in collaboration with, or in complementing research activity undertaken elsewhere.

Collaborative research infrastructure

In seeking to achieve the best outcomes for the community as a whole, a focus of the NCRIS program is on providing the drivers for the community to collaborate in developing research infrastructure. The use of a collaborative approach from the outset was reinforced by the decision to develop national capabilities and an awareness that it is important to locate infrastructure where it will have the maximum national benefit.

This approach is distinct from the provision of funding for research, where intense competition within the community may be valuable in driving up research quality. The

emphasis on a collaborative approach for research infrastructure development was intended to drive a substantial cultural shift within the research community.

The 2008 Roadmap identified the economic and efficiency arguments for a collaborative approach to establishing research infrastructure that enables world-class research. In the main, single institutions on their own cannot achieve the levels of research infrastructure needed to support such research. Economically, it makes sense for the Australian Government, universities, state and territory governments, non-profit research institutes and business to cooperate in implementing these research infrastructure investments[25].

> 'Efficiency gains reside not only in avoiding duplication in the creation of the infrastructure, but also in optimising its use, such that a piece of research infrastructure can be used to its maximum available capacity and that it is used to conduct the best research projects. To promote this greater use of the infrastructure, access regimes that provide for infrastructure to be broadly available to researchers across Australia were key elements of investment plans for NCRIS capabilities. An added benefit of the collaborative environment created by joint investment and development of the infrastructure was the requirement for the host institution to implement such open access regimes'[26].

Broad definition of research infrastructure

At the outset the NCRIS Committee recognised that facilities funded under the program would, of necessity, represent enormous diversity in infrastructure type, institutions, people, and style of operation. Thus it was decided that a one-size-fits-all approach would not be appropriate and that a principles-based approach would be used to guide the selection, development and implementation of NCRIS capabilities. In order to ensure maximum impact of the overall investment in research infrastructure, a broad definition of infrastructure was embraced. For some capabilities, this recognised that data sets constitute the most effective infrastructure.

Consideration of funding of operational costs

Drawing on the findings of the National Research Infrastructure Taskforce, the NCRIS Committee recognised that research infrastructure invariably involves establishment, governance and running costs and the provision of support staff, particularly highly skilled technicians, to enable most effective use of sophisticated facilities. If these elements are not provided then the infrastructure that has been established runs the risk of sub-optimal usage as host institutions are often unable to

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[25] p 4 in DIISR, 2008. *Strategic Roadmap for Australian Research Infrastructure*.
[26] p 4 in DIISR, 2008. *Strategic Roadmap for Australian Research Infrastructure*.

fund these support costs. The NCRIS Committee therefore recommended that funding for ancillary costs, to ensure effective deployment and ongoing use of the facilities created, be incorporated into investment plans. Funding could also be applied to technical staff to help create a critical mass of skilled technicians essential for maintaining a robust national research infrastructure capacity.

Use of facilitators

To implement a strategic and collaborative approach to research infrastructure development, the NCRIS Committee appointed facilitators for each capability to develop a strategic perspective of the needs of the relevant community and then, given the available funding envelope, determine which investments would make the most effective first steps in achieving the strategic goals.

The facilitator's role was to bring together the relevant community (and in some instances to create the community) and develop a strategic investment plan for the creation of that capability. Each facilitator was guided by a mentor nominated from the NCRIS Committee. In developing the investment plans, facilitators worked with researchers, research managers, research funders and users to define the infrastructure requirements and the collaborative arrangements for managing the operation and accessibility to facilities and equipment. It was required that the resulting facilities represent excellence in their respective capability area.

Stakeholder engagement

Significant investment in research capability occurs through the Australian Government, state and territory governments and through industry. In order to include input from such agencies, an NCRIS State and Territories Group, chaired by the NCRIS Committee Chair, was established to facilitate communication.

While the facilitators were primarily tasked with engaging with the scientific community to develop investment plans for each capability, the NCRIS Committee members and senior officials from the Department of Education, Science and Training consulted widely with senior officials from universities, publicly funded research agencies and state and territory governments to promote the NCRIS program and to obtain support for co-investment in NCRIS capabilities.

Evaluation of the NCRIS Program

The Evaluation Team examined the NCRIS program in the context of each element of the terms of reference [27], drawing on the evidence provided by the stakeholder surveys conducted by the department and the reports provided by the Science Panel[28] and the Economic Consultant [29].

The NCRIS evaluation terms of reference are addressed in order below.

Appropriateness

The NCRIS evaluation considered whether there is a demonstrated need for NCRIS as a government program, whether the NCRIS program is consistent with current government policy and if the NCRIS approach is the best way to address the need for a national process to identify, prioritise and fund medium- to large-scale research infrastructure needs.

The appropriateness of the NCRIS program was examined by considering the extent to which the program has improved resource allocation compared with previous and alternative programs.

Government support for research infrastructure

Rationale for government investment in research infrastructure

Assessing the appropriateness of a program means determining whether the logic of the program is the best way of achieving the program's objectives. This entails consideration of: whether there is an issue warranting a policy-based solution; if achieving the stated objectives of the program will address the original issue; and whether the program design represents the best way of achieving the program's stated objectives.

With respect to the need for government support for research infrastructure, there is a strong economic case for government funding of major components of research infrastructure along the lines of that provided by NCRIS. This need for government support for research, and hence the underpinning infrastructure, was articulated in the Productivity Commission's 2007 report *Public Support for Science and Innovation* [30] and reiterated in the *Review of the National Innovation System* [31].

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[27] See **Appendix A.**

[28] Science Evaluation Panel, 2009. *Report from Science Panel for NCRIS Evaluation Team*.

[29] Allen Consulting, 2010. *Evaluation of the National Collaborative Research Infrastructure Strategy Economic Analysis*.

[30] p xvii in Productivity Commission, 2007. *Public Support for Science and Innovation.*

Government support can be expressed in terms of addressing market failure, as infrastructure would tend to be undersupplied without public support. The rationale for government funding in research infrastructure is largely based on the broader rationale for government funding of research *per se*. This rationale is underpinned by there being significant public benefits from research. In addition, the private benefits received by researchers through licensing and other revenues derived from research outcomes are insufficient to cover costs, such that research would not take place, or not on the same scale, in the absence of government funding. Hence, the social benefits (private plus public benefits) of selected research are such that society would be significantly worse off in the absence of selected research taking place[32].

Public benefits from research

Public benefits from research include the diffusion of new ideas, processes and adapted technologies. Advancements of social wellbeing, sustainability of the environment and national security are also public benefits that may arise from government funding of research.

Funding of collaborative infrastructure may encourage a greater degree of information sharing and greater concentrations of human capital, leading to improved research capacity and advancement of ideas and technologies. Increased foreign investment in the Australian research sector may also flow from heightened levels of research infrastructure. Easier public and private access attributed to the collaborative nature of research infrastructure investment is a positive externality likely to arise from this mode of investment [33].

Private sector investment in research infrastructure funding

The private sector funds and conducts a large proportion of total research and development in Australia. In 2006-07 businesses and private not-for-profit research agencies contributed 60.2 per cent of total research funding in Australia[34]. However, although private firms do invest in their own research infrastructure, this is typically to support research at the 'applied' or commercialisation end of the research spectrum. Much of this research is commercially sensitive and not collaborative in nature. It is therefore unlikely that the private sector would be willing or able to provide sufficient investment in, and access to, research infrastructure to achieve the desired access for public researchers. The objectives of any privately-owned facilities that may be

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[31] DIISR, 2008. V*enturous Australia - building strength in innovation.*

[32] p 2 in Allen Consulting, 2010.

[33] Productivity Commission 2007, *Public Support for Science and Innovation*, cited p 3 in Allen Consulting, 2010.

[34] Australian Bureau of Statistics, 2008. *Research and Experimental Development, All Sector Summary, Australia, 2006-07*.

made accessible to some public researchers will, by necessity, be aligned with commercial outcomes to ensure the return on investment. Therefore access to these facilities is likely to be made available for research that aligns with the commercial interest and this access may not be readily available to the wider research community[35].

Nevertheless there is a potential role for the private sector within a collaborative research infrastructure model like NCRIS. Commercial users of facilities provide financial support through access fees. In some capabilities, it is anticipated they may also be in a position to partner within capabilities where they are willing and able to make some research infrastructure accessible. However, industry is unlikely to be a significant source of funding for publicly accessible research infrastructure[36].

Consistency with current government policy

The NCRIS program has been endorsed in both the Review of the National Innovation System and in Powering Ideas.

> 'The government recognises that Australia's public research capability has been constrained by underinvestment in strategic research infrastructure.'
>
> 'The National Collaborative Research Infrastructure Strategy has been effective in marshalling Commonwealth, state, territory, not-for-profit, and industry resources to fund major research facilities.'
>
> 'Redressing [the under investment in strategic research infrastructure] requires careful planning, close collaboration between stakeholders, and rigorous priority-setting. It is essential that expensive equipment is shared [so] that it is accessible to as many researchers in as many institutions as possible[37].'

Substantial funding for research infrastructure has been provided through the Super Science Initiative. Allocation of this funding was based on the 2008 Roadmap [38] developed as part of the NCRIS program. Thus the evidence-based, strategic approach embodied by NCRIS has been endorsed by government in its ongoing use as a basis for the allocation of infrastructure funding.

> **Key Finding:**
>
> *There is a clear, ongoing need for government funding of research infrastructure. It is appropriate, and consistent with current government policy,*

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[35] p 4 in Allen Consulting, 2010
[36] p 4 in Allen Consulting, 2010
[37] p 38 in DIISR, 2009. *Powering Ideas: an innovation agenda for the 21st century.*
[38] DIISR, 2008. Strategic Roadmap for Australian Research Infrastructure

that government provide funding to create research infrastructure to enhance the national innovation system and to foster collaboration.

Impact of the NCRIS model on resource allocation

The NCRIS model

An underlying assumption of the NCRIS program is that many high-priority, medium- to large-scale research facilities or infrastructure investments are too large or complex to be supported by any single research institution and too important to the wider research community to be confined to individual interests or jurisdictions. In a moderately-sized economy such as Australia, one challenge facing policy makers is how best to allocate limited resources for such infrastructure in a way that facilitates high-quality research, while maximising benefits to the Australian community. The NCRIS program sought to limit the waste of scarce resources that is likely to result from competitive or uncoordinated duplication of key research facilities. NCRIS used a collaborative approach to identify research priorities and to develop specific research infrastructure proposals.

Following the completion of the 2006 NCRIS Strategic Roadmap, a single national, collaborative proposal was developed to address each area of capability. This was achieved by appointing a facilitator with pertinent knowledge of the relevant sector. The role of the facilitator was to liaise with stakeholders to identify infrastructure requirements and develop an investment plan to address those needs.

A key feature of NCRIS was the use of collaboration to develop these investment plans. Furthermore, by applying the principle that provision of NCRIS funding must be accompanied by access arrangements for meritorious researchers, collaboration both between and within disciplines was facilitated.

Decision-making on the allocation of funding for NCRIS was informed by a long-term planning tool, the strategic roadmaps. The first roadmap was developed in 2006, with a revised and updated version released in 2008. These roadmaps identified areas where Australia should make strategically important research infrastructure investments to develop its research capability. The roadmapping process established a firm foundation for the allocation of funding. By identifying priority areas through a systematic and consultative process, the 2006 NCRIS Strategic Roadmap allowed the NCRIS Committee to focus on resource allocation that addressed the highest priority national capabilities and in the main avoid institutional and discipline rivalries. This useful tool has been emulated in several other countries[39].

Key Finding:

[39] for example the Netherlands, Sweden and Finland.

The roadmapping process that underpinned decision-making in the implementation of the NCRIS program provided a firm foundation for the allocation of funding. The systematic and consultative approach to resource allocation ensured that the highest national priority capabilities were addressed.

With appropriate, regular updates, this process is recommended for future research infrastructure funding programs.

Use of facilitators

Facilitators were used to engage the research community involved with a capability to work together to bring forward investment proposals optimising resource allocation within each capability. The collaborative focus of the facilitation process, and the leadership responsibilities imbued in the facilitators, provided a means of bringing together in some cases previously isolated members of the research community, and encouraged them to focus on the holistic needs of their capability. In addition, the independence of the facilitators was seen to give the process credibility. The relationship between the facilitation process and the NCRIS Committee and the department was generally seen as an appropriate method of developing nationally strategic infrastructure[40].

Stakeholders consulted as part of the evaluation expressed a general consensus that the facilitation process had been effective in providing research infrastructure[41]. Capability stakeholders were particularly supportive of the role the facilitation process played in determining infrastructure needs and developing plans for infrastructure investment. In their formal responses to the evaluation team, they tended to describe the facilitation process as having been 'first class', 'very effective' and 'highly effective', and having provided clear and sufficient direction (several survey responses). The facilitation process was also seen as having 'had a high level of community support and acceptance, particularly as the same process was required by the participants for the allocation of the recent EIF funding' (further survey response). Another survey response provides further support for this view:

> '... in relation to the engagement with the relevant research community, it is noteworthy that the facilitation process was reviewed soon after it was completed. Now, several years on, [this capability] feels that those findings remain a fair assessment: the extensive series of roadshows and consultation sessions, the detailed public-discussion papers, the counsel of an independent reference group as well as that of the NCRIS Committee, the web-site that was updated daily for three months and the transparent

[40] p 13 in Allen Consulting, 2010.
[41] p 12 in Allen Consulting, 2010.

> faithfulness to the NCRIS strategic roadmap provided ample opportunity for engagement by the relevant research community.'

Stakeholders suggested four ways in which the facilitation process was effective, especially in comparison with alternative approaches to determining infrastructure needs and developing investment plans.

First, the facilitation process was given sufficient guidance and boundaries to ensure a successful outcome. One survey response noted that:

> 'both the strategic roadmap documents and the counsel of the NCRIS Committee were significant parts of making the facilitation process effective. The roadmap and the active engagement of the counsel served to provide high-level strategic parameterization and guidance to the facilitation process, and these are important elements for success that would need to be in place if this process were to be repeated for future funding programs.'

Second, the collaborative focus of the facilitation process, and the leadership responsibilities imbued in the facilitators, provided a means of bringing together individualistic members of the research community, and encouraging them to transcend their institutional concerns and focus on the holistic needs of their capability. A survey response states:

> 'These [areas of the science community] have been traditionally very fractious. As such, the facilitator role was essential in centralising discussion around building cohesive capability rather than individuals and/or institutions developing siloed facilities. The facilitator also provided leadership outside of the large and established capability and ensured niche needs (geographical, technological etc.) were considered in the context of national priorities. The capability would not have been developed in its current format without the role of the facilitator.'

Third, the independence of the facilitators gave the process credibility, allowed for a wide range of stakeholders to be involved, and as one survey response noted, left 'the final recipients of [this capability] support "free" of criticism from the groups that inevitably missed out on funding from the process.'

Lastly, the relationship between the facilitation process and the NCRIS Committee and the department was seen as an appropriate method of developing nationally strategic infrastructure. A survey response stated:

> 'The facilitation process worked very well. It was useful to develop a proposal in cooperation with the funding body. This is completely different from traditional ARC-type approaches but it seems very appropriate for the funding of national infrastructure (as opposed to funding of institutional-based research/infrastructure).'

However, the process of using a facilitator was not without issues. Some stakeholders felt that the process did not produce a 'complete' outcome, with difficulties experienced in the transition period between the end of the facilitation and the establishment of the projects. Another view was that considerable pressure was placed on single facilitators to achieve results and that this posed a risk to the successful development of a capability[42].

The success of the facilitation process depended on the combination of interpersonal and technical skills and the energy of the facilitator, and it did not always work optimally. However, facilitation does appear more likely to deliver tangible outputs on time than, say, a process involving a layer of committees.

The need for facilitators to bring a combination of independence and status/expertise in the field was discussed at length with many key stakeholders, and recognised to be a difficult balance to strike. But overall, the use of facilitators in bringing together the capabilities is seen as an important element of the NCRIS process, particularly where the facilitators had experience across the university/government laboratory/industry spectrum, with their role having been important for making what was essentially an effective community model[43].

Key Finding:

Facilitation achieved effective resource allocation within capabilities and is an appropriate mechanism for developing national capabilities.

The choice of facilitator is critical to the success of a facilitation process. The balance between the need for an independent facilitator and the need for the facilitator to have standing in, and knowledge of, the relevant community needs careful consideration.

Collaboration and economic benefits

From an economic perspective, the collaborative approach to developing infrastructure proposals is justified on the basis of:

- substantial economies of scale from research infrastructure (e.g. one large facility is likely to be able to support more and higher-quality research than several, smaller facilities that may lack the critical mass to attract meritorious researchers); and
- collaborative research infrastructure involving multiple partners has the potential to generate more valuable research outcomes than is likely if research facilities were instead only accessible by a single body or university.

[42] p 13 in Allen Consulting, 2010.
[43] p 14 in Science Panel Report, 2009.

Economies of scale have been achieved through capabilities being able to reduce the number of operating sites. For example, the AuScope project (established under the Structure and evolution of the Australian continent capability) advises that the co location of infrastructure achieved through NCRIS has reduced establishment and operating costs.

Having larger, but fewer, research facilities brought about by NCRIS has enabled capabilities to have a stronger purchasing power when procuring specialist equipment. For example, Bioplatforms Australia (established under the Evolving bio-molecular platforms and informatics capability), the Australian National Fabrication Facility and AuScope have indicated that significant procurement savings have been made[44].

Key Finding:

Collaboration naturally drives a broader perspective and is good for resource allocation within a capability.

Comparison with other research infrastructure funding models

A comparison of NCRIS with the three main Australian Government programs for funding research infrastructure existing before the NCRIS program shows that, with respect to funding, coverage, collaboration and certainty, the NCRIS model is superior (see **Table 2**). The programs considered were:

- the Systemic Infrastructure Initiative (SII) (2001-02 to 2005-06);
- the Major National Research Facilities (MNRF) Program (2001-02 to 2005-06); and
- the ARC Linkage Infrastructure, Equipment and Facilities (ARC LIEF) Program (2002-current)

Table 2 Research Infrastructure Programs Funding Models

	Funding coverage	Collaboration	Certainty
SII	Partial funding only (often only initial capital costs). Institutions required to meet	Submission based. Submissions did not necessarily reflect overall infrastructure	*Ad hoc* decision-making so planning difficult. Also lack of employment certainty

[44] p 6 in Allen Consulting, 2010.

	shortfalls.	priorities, or encourage collaboration and co-investment.	for skilled staff.
MNRF	Partial funding only (often only initial capital costs). Institutions required to meet shortfalls. Funding back-end loaded.	Submission based. Submissions did not necessarily reflect overall infrastructure priorities, or encourage collaboration and co-investment.	*Ad hoc* decision-making so planning difficult. Also lack of employment certainty for skilled staff.
ARC LIEF	Partial funding only (often only initial capital costs). Had not kept pace with competitive grants.	Funding directed to established researchers in larger institutions and away from smaller institutions and evolving areas of research.	
NCRIS	Fixed costs (initial capital costs, and 'standing' operating costs).	Collaboration built into process from beginning of proposal development, through to infrastructure development and operation.	Certainty provided for initial life of infrastructure, with funding provided for ongoing fixed costs.

Notes: SII = Strategic Infrastructure Initiative, MNRF = Major National Research Facilities Program, ARC LIEF = Australian Research Council Linkages Infrastructure, Equipment and Facilities Program.
Source: Allen Consulting Group, Analysis of the Department of Education, Science and Training, 2003[45]

Of the above programs, the ARC LIEF program provides funding that satisfies a different niche compared with the NCRIS program, as illustrated in the continuum of research infrastructure funding (see **Figure 1**). The comparisons made in **Table 2** demonstrate that the two programs that preceded NCRIS, i.e. the SII and the MNRF programs, were not as appropriate as the NCRIS program in the provision of a systemic and strategic approach to funding research infrastructure. Both the SII and the MNRF programs were found to be less appropriate because of the *ad hoc* approach to decision-making, and the lack of employment certainty for skilled staff[46].

Key Finding:

[45] p 9 in Allen Consulting, 2010.
[46] p 8 in Allen Consulting, 2010.

The NCRIS model is appropriate for funding medium- to large-scale, capability-based research infrastructure and, for this type of infrastructure, is superior to previous models. The analysis shows that it has substantially improved the allocation of resources.

Effectiveness

Evidence was sought regarding whether NCRIS activities have clear and consistent objectives and if those activities are effective in achieving these objectives.

The evaluation examined the impact of the NCRIS program on research and whether research outcomes have been improved. In examining this point, the evaluation sought to establish what NCRIS has provided and whether NCRIS-funded infrastructure has met research needs and provided world-class infrastructure that has fostered world-class, collaborative research. In other words, has the NCRIS approach to providing research infrastructure been effective?

The evaluation considered whether the NCRIS program has been cost-effective and if the NCRIS activities represent value for money for the expenditure of taxpayer funds

Meeting NCRIS program objectives

The stated objectives of the NCRIS program, as distinct from the objectives for each individual NCRIS capability, are to:

- provide major new, and leverage existing, research infrastructure that is national, strategic, collaborative and world-class;
- promote a sustained cultural shift towards investment attitudes that are national, strategic and collaborative; and
- foster research activity that is collaborative and world-class.

These objectives have been applied widely across the NCRIS program and have been effective in driving research infrastructure outcomes across a diverse range of infrastructure requirements. Performance of the NCRIS program against its stated objectives is discussed in the following sections.

Provision of research infrastructure that is national, strategic, collaborative and world class[47]

New research infrastructure

[47] For a list of the facilities established under each capability, see **Table E1: Appendix E**.

The NCRIS program has created significant new infrastructure for the nation. Examples include the new Plant Accelerator building at the University of Adelaide node of the Australian Plant Phenomics Facility and the Atlas of Living Australia (ALA) (both facilities in the Integrated biological systems capability). The ALA is essentially soft infrastructure that provides a framework and tools to achieve outcomes not previously possible (see **Case Study 2**) [48]. New infrastructure has also been developed in the Biotechnology products capability facilities for Recombinant Proteins, Biofuels, and the Manufacture of Human Cells for Transplant. The Population Health Research Network, the Australian Biosecurity Intelligence Network (of the Networked biosecurity framework capability), the Terrestrial Ecosystem Research Network and the Platforms for Collaboration components aim to build new, largely information- and tools-based networks underpinning their respective capabilities.

Several NCRIS capabilities were created by building on, re-aligning and integrating previously disparate research facilities and equipment. Examples of where this has been particularly effective are AuScope and the Integrated Marine Observing System (IMOS – **Case Study 3**). As the IMOS survey response noted:

> 'IMOS has revolutionised ocean observing in Australia by bringing together fragmented pockets of capability and building a suite of national facilities with critical mass, that take advantage of institutional strengths. It is enabling more multi-disciplinary, whole-of-system approaches to be taken through to national-level planning. It is enabling new collaborations to be established e.g. between ocean-observing and the modeling communities developing next-generation, data-assimilating ocean models[49].'

Other NCRIS capabilities that were built on pre-existing infrastructure include the Australian Phenomics Network (under the Integrated biological systems capability), Optical and radio astronomy, the National Imaging Facility, the Australian Microscopy and Microanalysis Research Facility, the National Deuteration Facility and the Australian Synchrotron (all under the Characterisation capability), Fabrication, and Bioplatforms Australia (incorporating Genomics, Proteomics, Metabolomics and Bioinformatics; created under the Evolving biomolecular platforms and informatics capability).

Leveraging existing research infrastructure

An example of effective leveraging of existing research infrastructure is the Australian Animal Health Laboratory (AAHL) Collaborative Biosecurity Research Facility (ACBRF), part of the Networked biosecurity framework capability, which has been

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[48] p 7 in Allen Consulting, 2010.
[49] IMOS Survey Response

created utilising the existing AAHL infrastructure located in Geelong, Victoria (**Case Study 4**).

Impact of the NCRIS definition of infrastructure

As recognised in the definition of research infrastructure adopted by NRIT, the assets constituting infrastructure for a given scientific research capability can be quite varied and often extend well beyond just physical assets. Consistent with this view, NCRIS adopted a flexible approach to what constitutes infrastructure so as to satisfy the specific requirements of the different capabilities.

This definition of infrastructure, and the recognition of data and information as infrastructure, is central for some capabilities. The observation-based capabilities such as IMOS (see **Case Study 3**) and AuScope are providing continuous data streams of critical information about processes that operate on long time scales, such as ocean-climate dynamics, or tectonics of a continent, and that lead to understanding of climate change or natural hazards. They provide timely access to quality-assured observational data that can be used by the Australian research community. Together with the data, these facilities are providing the tools for effective use of these data streams, allowing them to be used by a wider community of researchers including for the development of applied user products [50].

Ongoing support for these data streams is essential to maintain the value of the original investment. New research outcomes will be driven by the improvements in temporal and spatial resolution of the record as well as by the increasing interactions between the users of the data streams. This is not a static process. The dynamic nature of the phenomena being observed means that it is an ongoing observation task. Interruptions in the data streams significantly reduce their value as infrastructure, so continuity is critical for as long as the impacts of the phenomena are considered to be important. This view of infrastructure has also created new opportunities for researchers. One of the things achieved under the NCRIS program is the introduction of technologies and data streams not otherwise available to individual researchers or even institutions [51]. This will increasingly create the flexibility to use these facilities as new research challenges emerge in areas requiring multi-disciplinary approaches.

A feature of the NCRIS program receiving strong support from the research community is the ability to develop large infrastructure where this cannot be purchased off-the-shelf or where the existing components need to be field-tested first and where, in consequence, there are considerable developmental costs. This is achieved through the provision of phased funding that includes technical and

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[50] p 26 in Science Panel Report, 2009.
[51] p 28 in Science Panel Report, 2009.

professional staff to build and test the facility, recognising that in some instances research outcomes will not be achieved within the lifetime of the program. The capacity to engage in this type of high-risk/high-reward research infrastructure development enhances Australia's capacity to lead in research rather than simply to respond to infrastructure trends. The ability to use NCRIS funding for operational costs for the period of the NCRIS funding is also seen as a strong positive feature [52].

The NCRIS approach to providing research infrastructure has been effective. The roadmapping process appears to have established a firm foundation for the allocation of funding, and the facilitation process is widely regarded as having been effective in determining infrastructure needs and developing investment plans [53].

The facilitation process ensured that infrastructure requirements were prioritised based on national considerations and allowed for the utilisation of existing facilities and infrastructure. This strategic and collaborative approach with wide consultation resulted in infrastructure that is both cross-institutional and non-exclusive [54].

Key Finding:

The NCRIS approach has been successful in achieving the creation of improved national research capability by embracing a broad definition of infrastructure to develop new facilities and leverage existing capacity.

Case Study 2. Atlas of Living Australia

The aim of the Atlas of Living Australia (ALA) capability is to develop a biodiversity data management system to link Australia's biological knowledge with its scientific and agricultural reference collections and other custodians of biological information. The system plans to be authoritative and freely accessible .

By 2011 the Atlas of Living Australia (ALA) capability will be achieving research outcomes not possible previously. This capability advises that these outcomes are made possible through the comprehensive and collaborative approach to research facilitated by NCRIS. These outcomes include:

- integrated mapping of data for all Australian species using data from collections and field research;
- tools and systems to maintain an integrated national list of all species occurring in Australia, and improved management of institutional and agency data sets;

[52] p 13 in Science Panel Report, 2009.
[53] p 12 in Allen Consulting, 2010
[54] p 12 in Allen Consulting, 2010.

- improved capacity for Australian natural history collections to curate and digitise material collected from field research and ecological monitoring activities;
- national repositories for management of biodiversity-related images, digital literature, voucher-based molecular sequence data and identification tools;
- engagement of amateur naturalists as citizen-scientist contributors to research activity;
- integrated search tools and information presentation for all Australian species; and
- data quality processes including user annotation tools.

Case Study 3. Integrated Marine Observing System, IMOS

Australia's marine jurisdiction, the third-largest in the world, covering an area more than twice that of its land mass, is one of the least explored and understood. Yet, as an island nation that is highly sensitive to its ocean-influenced climate and which extracts significant economic benefit from its vast ocean territory, Australia's marine research efforts had been scattered and disjointed.

IMOS involves a new level of collaboration between Australian Government and state agencies, and research institutions across the country to provide a nationally designed, systematic and long-term observation program that can be used to study the entire ocean environment.

The concept that data streams can constitute infrastructure is critical for IMOS, where marine data and information is provided as continuous data streams to the user community.

Iain Suthers, Professor of Marine Science at the University of New South Wales said 'IMOS has done far more than just deliver $50 million of infrastructure, it has brought together a community of marine scientists – human capital that has put us ahead before we even start thinking about the data streams.'

Professor Tim Moltmann, IMOS Director, said 'It is now becoming clear that the IMOS approach to bio-physical integration, linking from global to regional scales, and providing free and timely access to data, places it at the leading edge of global ocean observing system development for the next decade. While Australia is challenged by having such a large ocean territory relative to the size of its population, the NCRIS program has enabled development of a truly national, integrated system that is the envy of much larger nations.'

'By investing in the full cost of delivering data that can actually be taken up and used by the science community, it has transcended the "bricks and mortar" view of

research infrastructure and created a new “data-access” paradigm that, in the marine and climate domain, is being recognised internationally as a world-leading approach.’

As long as these data streams are acquired in an unbroken sequence, their value will increase over time as further knowledge and understanding is generated. Interruptions in the data stream directly diminish the value of the infrastructure and so it must be recognised that, for as long as the scientific aims are deemed to be of high priority, the core infrastructures of such programs have to be maintained in a continuous manner.

One of the world’s leading oceanographers, UK-based Professor of Oceanography, John Gould, an international representative on the IMOS advisory board, believes IMOS has placed Australia at the forefront of global marine research and will become a model for other countries.

Case Study 4: Australian Animal Health Laboratory (AAHL) Collaborative Biosecurity Research Facility (ACBRF)

AAHL is one of the most sophisticated laboratories in the world for the safe handling and containment of infectious microorganisms and is the only laboratory in Australia approved to work with exotic animal disease agents. As such it plays a vital role in maintaining Australia’s capability to diagnose exotic and emerging animal diseases quickly and accurately. This world-class infrastructure is also accessible to researchers working in the fields of: biosecurity; plant health; and new and emerging zoonotic diseases, which have potential impacts on human as well as animal health.

With a current replacement cost estimated at $650 million, AAHL is a major national facility managed by CSIRO.

The ACBRF is an NCRIS-funded facility established at AAHL. NCRIS funding of over $10 million has been provided to expand the microbiologically secure laboratories at AAHL, including the development of specialist microscopy services, to create the ACBRF.

The ACBRF is providing around 2,000 m2 of specialised laboratory space for projects requiring high biocontainment in a biosecure environment.

Access to the ACBRF is granted on the basis of scientific merit with preference given to projects that are strongly aligned with Australia’s National Research Priorities and that have a clear path to impact.

While not part of the ACBRF itself, several other facilities and services located at AAHL will also be accessible to non-CSIRO researchers, subject to separate arrangements.

Through a modest investment, NCRIS has been able to facilitate increased access to, and increase the scope of, a major piece of CSIRO infrastructure and expertise. This capability is now available to a wide range of researchers working on issues relevant to Australian biosecurity.

Evidence for a sustained cultural shift towards investment attitudes that are national, strategic and collaborative

An objective of NCRIS is to foster collaborative and world-class research. This objective means that NCRIS aims to encourage collaboration in research in its own right, not just as a means of developing or utilising infrastructure. While encouraging collaboration is a government objective, as stated in *Powering Ideas*, the focus of this assessment is on the quality and utilisation of the research infrastructure itself and on the research outcomes in terms of enhancing the nation's ability to deliver world-class research.

The process of roadmapping and the use of facilitators to focus the development of projects was an important element in encouraging the development of collaborative approaches to research infrastructure development. The insistence on collaboration within and across all boundaries was reported by the science community as one of the strong, beneficial aspects of the NCRIS approach [55].

An important element in making the collaboration effective was the role of the facilitator in developing the investment plans. This led to the creation of capabilities that enjoyed general support from within the disciplines and from the end-user community. Collaboration in developing the NCRIS capabilities has taken place within disciplines, across disciplines, between university researchers and the state and Australian Government agencies, with other research centres such as Cooperative Research Centres (CRCs) and Rural Research and Development Corporations (RRDCs), and with industry involvement [56].

Collaboration with states and industry

Some state government stakeholders felt that NCRIS had been particularly effective in bringing industry into collaborative arrangements with academia, as it allowed state governments to provide support, particularly in instances where state development could only occur if industry were involved. Industry considered that there were many leverage opportunities in the NCRIS funding. However a concern

[55] p 10 in Science Panel Report, 2009.
[56] p 17-18 in Science Panel Report, 2009.

was raised that some institutions had promised ‘matching’ funds but were unable to deliver, resulting in problems of ‘over leveraging’[57].

Collaboration within the research sector

While the collaborative approach of NCRIS has been effective in governing and managing infrastructure within capabilities, it is less clear how effective NCRIS has been in facilitating collaboration between researchers, institutions, government and industry. This may be a consequence of the relative newness of the NCRIS program, as some capabilities have only been fully established in the past year[58].

Collaboration has been an important element in existing research funding programs, including the ARC and NHMRC programs and the CRC programs. NCRIS is distinctive in that the program has required collaboration from the earliest planning stages of proposals across a broad range of participants and agencies. In contrast, in other programs, the collaboration typically comes only once the broad scope of the project has already been identified and collaboration is then used largely to fill gaps[59].

As a consequence of this early collaboration, it was quickly recognised by the research community that many of the potential capabilities within the NCRIS program were going to be too large or too complex to be developed and operated by any one agency, and that the benefits of the program would be greatly enhanced if other players were brought into it. It was also recognised that the outcomes of some of the capabilities were beneficial to the objectives of the separate agencies involved.

There is a concern that if collaboration is pushed too far then diversity will be lost and that people will attempt to use a one-size-fits-all approach. Within NCRIS, diversity was maintained within capabilities with investments in smaller sub-capabilities that were encompassed in a national facility. An example of this is in the Characterisation capability, where separate investments were made in imaging, microscopy, deuteration, and synchrotron beam lines under the Characterisation umbrella.

International engagement

Collaboration within NCRIS capabilities has also facilitated engagement with international researchers. One capability manager observed that international visitors have been ‘amazed’ at the level of collaboration (especially cross-disciplinary) occurring as a result of the setting up of the capability, and that many previously unanticipated connections were being made. Many of these collaborations have been facilitated by the technical staff funded under NCRIS. This result was compared with

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[57] p 19 in Science Panel Report, 2009.
[58] p 17 in Allen Consulting, 2010
[59] p 10 in Science Panel Report, 2009

outcomes from the MNRF program where the competitive-bidding process was seen to drive a non-productive, siloed approach [60].

Influence of collaboration on achieving capability objectives

Capability stakeholders generally maintained that collaboration in managing NCRIS infrastructure had a positive influence on their ability to achieve their objectives. They stated they had found that a collaborative approach allows for participants to share learnings and mutually improve performance across key areas [61]. One capability described how its nodes 'share training resources, including notes, instrument manuals and teaching staff'. As a consequence, 'best practice is shared among the national facility, duplication is prevented and staff expertise is available nationally, not just at a local institution'. This capability also noted that the quarterly meeting of its laboratory managers 'to discuss issues related to facility operation and management' has resulted in 'best practice in OHS compliance across the nodes'. Another capability response described how its platform committees:

> '... meet regularly and discuss latest advances in technology and research news as well as exploring opportunities to exchange information. This is particularly valuable when commissioning new equipment, since this is a great learning experience which can be passed onto others buying similar equipment.'

Another benefit highlighted by stakeholders was that a collaborative approach allows participants to pool resources. This can lead to enhanced bargaining power. One capability response illustrates this point:

> 'AMMRF Nodes and Linked Laboratories collaborate in joint instrument procurement. By packaging instrument purchasing, buying power is improved significantly. This has been demonstrated recently in the purchase of five transmission electron microscopes for three laboratories (one node and two linked laboratories). If purchased separately the total cost would have been approximately $6.3 million. By combining the purchases into a single negotiated deal, however, the total package price was $4.2 million resulting in a saving of about $2 million.'

Pooling resources can also help capabilities to minimise duplication. This capability response also states:

> 'Each year, the node directors discuss capability that needs to be added or upgraded at the local nodes and propose partners in the projects. This

[60] p 14 in Science Panel Report, 2009.
[61] p 17 in Allen Consulting, 2010.

process eliminates duplication of grant applications and results in target proposals that may have higher chance of a successful outcome.'

Key Finding:

The NCRIS program has broad community support and has engendered a trend towards a more strategic and collaborative approach to the funding and development of research infrastructure.

The impact of NCRIS on fostering research activity that is collaborative and world-class.

The tangible outputs delivered by and through the NCRIS program are projects directed at developing the twelve capabilities identified in the 2006 NCRIS Strategic Roadmap that received funding. The NCRIS facilities comprising the capabilities are summarised in **Appendix E**. The infrastructure required to enable leading-edge research differs significantly from capability to capability and even within capabilities[62]. It includes:

- observatory monitoring data streams that require long-term continuity to provide value (e.g. marine observations);
- observatory functions to search for specific phenomena (e.g. optical astronomy instruments);
- laboratory facilities that allow for a range of different chemical and/or biological processes and analyses;
- experimental facilities to replicate physical phenomena in a laboratory environment;
- fabrication and characterisation facilities to create and test new materials, structures and functions; and
- large-scale computational facilities and data manipulation infrastructure.

This infrastructure may comprise:

- facilities utilising large equipment;
- facilities requiring technical and professional human resources;
- framework data sets and data streams; and

[62] p 9 in Science Panel Report, 2009

- infrastructure that either supports basic research or that drives applied research and product development.

The infrastructure developed ranges in scale, and includes single-site facilities and nation-wide distributed systems. They involve partners and participants ranging from a single institution and discipline to large collaborative groups cutting across disciplines and across agencies. This includes universities, publicly funded research agencies such as CSIRO and the Australian Institute of Marine Science (AIMS), state government departments and agencies, Australian Government agencies such as Geoscience Australia, ARC- and NHMRC-supported laboratories and centres of excellence, CRCs and the Rural Research and Development Corporations (RDCs), international bodies such as the Wellcome Trust Fund and the National Institutes of Health (USA), and industry.

As noted above, the NCRIS program is recognised as providing a new model for funding medium- to large-scale infrastructure to support research needs and is directly comparable to its predecessor MNRF program and to the more recent EIF investments. Its principal features, recognised and appreciated by the science community, include[63]:

- a shift to a more strategic approach to the funding of research infrastructure;
- a broad and flexible definition of research infrastructure;
- inclusion of whole-of-life costs for the technical support to build, maintain and operate the infrastructure for the duration of the program;
- the emphasis on collaboration and the development of expertise within and across disciplines and across institutions; and
- the use of facilitators as a new approach for developing major infrastructure proposals.

As already noted, these features are seen as having produced a flexible program that can accommodate a range of different management structures and concepts of infrastructure that are accessible to the entire spectrum of researchers across Australia.

NCRIS is seen as having introduced a process to bring people together to define capabilities. It has also provided a framework to allow for greater creativity than was possible via other mechanisms, and resulted in more ambitious and high-impact capabilities being defined[64].

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[63] p 12 in Science Panel Report, 2009.
[64] p 12 in Science Panel Report, 2009.

In many cases, the NCRIS program is seen to be creating networked nodes of expertise integrated by complementary equipment and ICT tools, as well as more accessible and shared data[65]. It was commented by one capability CEO that NCRIS has achieved more than simply the provision of equipment. It has built the capability in its broadest sense; and the effective combination of infrastructure, skills and research relationships[66].

Collaboration and research outcomes

It is commonly accepted within the scientific research community that international-class research in certain disciplines requires, *inter alia*, international-class research infrastructure. The importance of collaboration in research for improving research outcomes is underpinned by the notion that having researchers from different institutions working collaboratively at a single facility generates higher research outcomes than if these researchers were in competition and working at their home institution[67].

The potential for superior research outcomes from a collaborative research approach has been confirmed in economics literature. This literature, focused upon private sector research, finds that there can be large 'spillovers' associated with collaboration[68].

Strong support for the collaborative NCRIS approach was expressed by the research community, including those who had received funding under other infrastructure funding models. Several capability responses illustrate this point.

> 'I would like to congratulate the team at DIISR for what is a fantastic initiative. In seeing the growing list of achievements of the program the value of a collaborative approach to infrastructure investment is becoming increasingly clear. In an environment of competitive grants and both institutional and state government rivalry this novel approach has shown remarkable success.'
>
> 'This particular objective of the capability could never have been achieved in the time frame without the NCRIS investment and the imperative to collaborate. NCRIS should be applauded for supporting this vision.'
>
> 'The NCRIS collaborative approach to providing infrastructure has been fundamental to the success of [our Capability].'

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[65] p 12 in Science Panel Report, 2009.
[66] p 11-12 in Science Panel Report, 2009.
[67] p 6 in Allen Consulting, 2010.
[68] p 4 in Allen Consulting, 2010.

‘The NCRIS collaborative approach to developing the [Capability] infrastructure has been incredibly valuable.’

NCRIS infrastructure enabling new collaborative research

An example of where increased collaboration has driven new scientific outcomes is provided by IMOS (see **Case Study 3**) where the new capability enables physical oceanographers who have previously worked on different scales – global, shelf or coastal zone dynamics – to work more effectively at the interfaces of these scales and thereby provide a more integrated understanding of ocean dynamics and the resulting impact on climate. The data streams generated by IMOS are underpinning research across a range of diverse disciplines such as climatology, oceanography, geophysics and marine biology.

Interdisciplinary research has also been fostered through the Bioplatforms Australia project. For example, crop physiologists and agro-ecologists identify crops in the field that perform particularly well under drought conditions, and can then connect this back to the metabolic profile of the plant through metabolomics. This has then led to genetic connections that can be used in crop improvement. The end result has been a virtuous cycle between the ecologists and eco-physiologists, the biochemists and the plant breeders, which did not exist before [69].

Quality of research outcomes

Australia is not in a position to achieve excellence in all areas of research endeavour and so should not attempt to fund research infrastructure outside areas in which Australia can achieve significant outcomes. Of necessity, this will mean some areas of infrastructure are not provided or, where they are, may not be at a scale sufficient for Australia to compete effectively. NCRIS prioritised a small number of capabilities and achieved prioritisation of investments within capabilities to ensure an adequate scale for each investment, and to have a systemic impact.

The process of roadmapping should minimise the prospects that infrastructure funded through NCRIS, or any other research infrastructure funding program, is not necessary or does not align with an Australian strength.

Evidence was presented to the science panel indicating that most capabilities have the potential to become world-class, and in some instances, are already setting new world standards[70].

For example, the AuScope geospatial component is seen as a major new effort at integrating the complementary geodetic techniques required to establish and

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[69] p 18 in Science Panel Report, 2009

[70] P 5, p 15 in Science Panel Report, 2009.

maintain a high-accuracy rapid-positioning system across the Australian region while at the same time contributing greatly to the improvement in the accuracy and stability of the global reference system.

NCRIS facilities have the potential to support world-class research. Whether the facilities will be seen as world leaders within the next five years or so, and be seen as having been critical investments that have changed the nature of the research activity, will depend very much on whether the momentum gained by the NCRIS program can be sustained [71].

Key finding:

NCRIS capabilities are supporting research activities that are novel, collaborative, and that are already, or have the potential to be, world-class.

A major negative, expressed by virtually all stakeholders interviewed by the Science Panel, was the absence of a clearly enunciated future of the capabilities at the end of the NCRIS funding. It was felt by the stakeholders that uncertainties about the future should not be allowed to linger, especially given the current risk to continuity of employment of highly-skilled technical staff. The capabilities' responses all indicate that they were built on the assumption that their lifetimes were to be greater than the funding cycle provided by the NCRIS program and that their true measure of success would only become apparent much later. All were established with the tacit or explicit recognition that funding beyond NCRIS would be required [72] even though NCRIS was established as a terminating program.

Key Finding:

Current uncertainty about future funding for research infrastructure, particularly the provision of funding for operating costs and specialist staff, creates management difficulties for current capabilities and places Australia at risk of losing the highly-skilled work-force required for the efficient operation of sophisticated facilities.

Cost-effectiveness

Leverage of co-investment

The 2006 NCRIS Strategic Roadmap identified sixteen priority capabilities, of which twelve were funded. A summary of the research infrastructure projects and the funding applied to each is at **Appendix E**. Information is also provided regarding the sources of funding for the priority capabilities, including NCRIS funds, cash co-

[71] p 15 in Science Panel Report, 2009
[72] p 22 in Science Panel Report, 2009

investment and in-kind co-investment. The proportion of funding for the NCRIS capabilities as a whole is illustrated in **Figure 2**, which shows that NCRIS funding comprised 42 per cent of the funds applied to the capabilities. Thus the capabilities have generally been successful in securing funds from a range of sources beyond NCRIS funding, though not from the private sector. The likely reasons for this are discussed in relation to appropriateness.

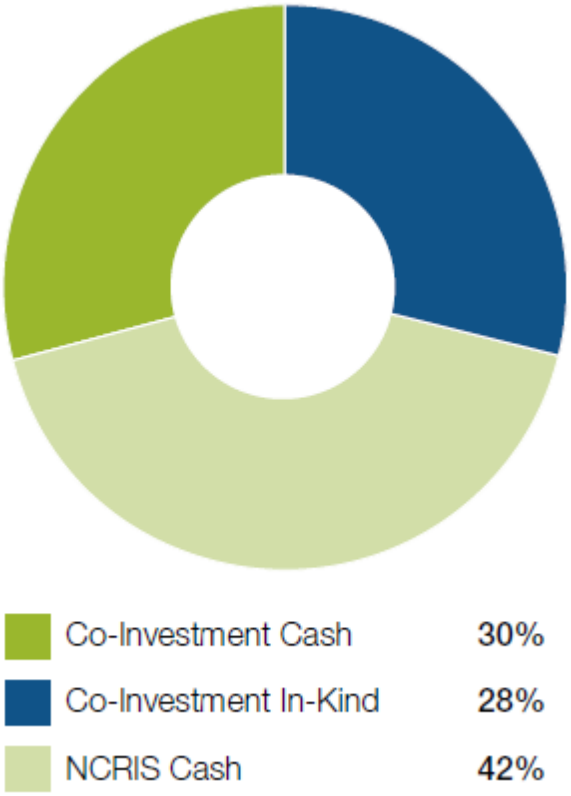
It is evident from **Table E:2 (Appendix E)** that there is a wide variation between different capabilities in the proportion of NCRIS funding contributing to the establishment and broader accessibility of the infrastructure. Clearly, with this variability in funding, it is not appropriate to use the level of cash or in-kind investments as an indication of there being a multiplier of the value of the capability in return for NCRIS funding. Further, as co-investment may also derive from government funding through other programs, or from block funding, there is not sufficient evidence to assert that NCRIS as a whole has generated a particular benefit for a specific investment.

Industry users provide support for facilities through the payment of user fees. The issue of user fees and access and pricing is discussed in relation to efficiency.

A key outcome of the program is that in the majority of cases, access is not dictated by host institutions, as had been the case under previous, competitive grant approaches to research infrastructure funding [73].

[73] p vii in Allen Consulting, 2009

Figure 2 Source of funding for NCRIS capabilities



Utilisation of NCRIS infrastructure

Cost-effectiveness may also be determined from utilisation rates or the extent of cost recovery through user fees. Even at a stage where not all NCRIS funding has been provided and not all capabilities are fully established, some capabilities are already demonstrating a high utilisation of the research infrastructure. Available usage data suggests that NCRIS infrastructure is being utilised by researchers in government agencies and industry as well as university researchers [74]. For instance:

- the Australian Phenomics Network reports that 208 users from 53 different research institutions accessed its capability in 2008-09 (survey response);
- Bioplatforms Australia notes that it had 1,670 users in 2008-09, 65 per cent of which came from the university sector, 18 per cent from the commercial sector, and 17 per cent from other publicly-funded research institutes (survey response); and
- the Australian Microscopy and Microanalysis Research Facility states that it had 2,824 users in 2008-09, 89 per cent of which came from the university sector, 5

[74] p 18 in Allen Consulting, 2010.

per cent from publicly-funded research institutes, 5 per cent from industry, and 1 per cent from 'other' (e.g. hospitals) (survey response).

The impact of provision of funding for skilled staff and operational costs on the effectiveness of the NCRIS investments

As highlighted in **Case Study 5**, the Characterisation capability investment has resulted in the blossoming of interdisciplinary research as a result of interactions with, and introductions facilitated by, NCRIS facilities. For example, the links between chemistry and biology have been substantially strengthened by the new ability to probe a broad range of length scales, and thus link fundamental science in these areas [75]. Central to this has been the provision of technical capability.

The provision of funding to cover operational costs provided by NCRIS has received strong support from across the research community. During the development of NCRIS, members of the research community raised concerns that previous infrastructure programs had tended to fund only the capital costs of the infrastructure. As a consequence, the host institution had to assume responsibility for covering the costs associated with operating the infrastructure, such as the salary costs of technical staff, consumables and utility costs. If the institution was unable to cover these operating costs through access charges or some form of cross-subsidisation, then the infrastructure was not likely to be viable in the long term. As stated in the NRIT Report [76]:

> 'A key concern was the tendency for infrastructure programs to provide only partial funding, often only initial capital costs. Feedback indicated that this imposes on research institutions a need to fund, or recover from access charges, operational, maintenance and refreshment costs, and the costs of providing skilled operators. Where this is difficult or impossible to do, infrastructure that would otherwise be productive and viable, risks becoming under-utilised or non-operational. There is a very strong feeling in the research community that assumptions that infrastructure can and should be self-supporting are flawed.'

To address these concerns, a key principle of the NCRIS program has been to ensure that due regard be given to the whole-of-life costs of major infrastructure, with funding available for operational costs where appropriate.

Provision of technical support or specialised assistance is an issue for the majority of users of NCRIS-funded facilities. In the survey of NCRIS facility users conducted as

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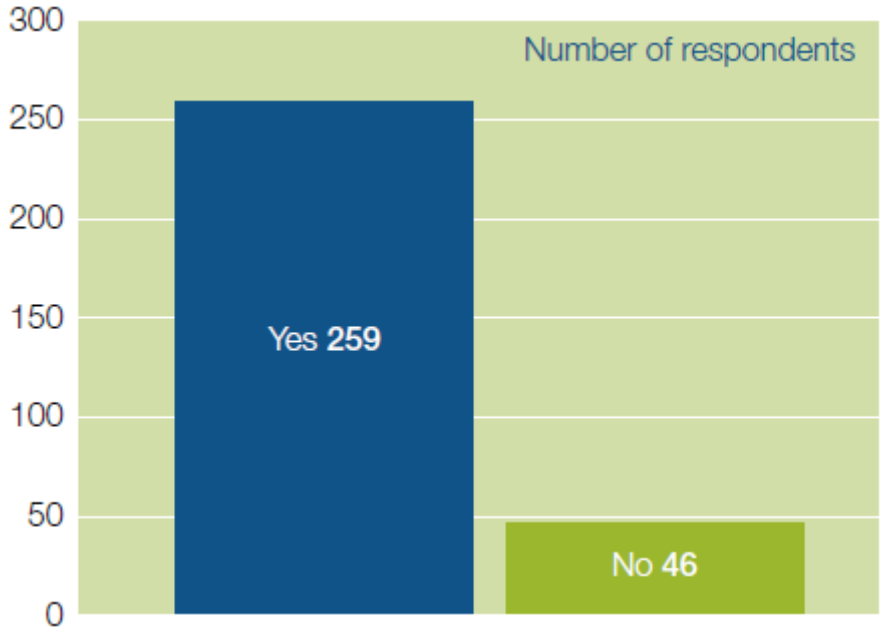
[75] p 18 in Science Panel Report, 2009.
[76] p 7 in DEST, 2004. *The Final Report of the National Research Infrastructure Taskforce*.

part of this evaluation, 85 per cent responded that they had received technical support or training when using the facility (see **Figure 3**) [77].

Figure 3 Were you provided with the technical support or training that assisted you in your use of the facility?



Capability stakeholders, in particular, highlighted the funding of technical staff under NCRIS as a leading factor behind the effectiveness of the model. The funding of technical staff is seen to have three main benefits [78].

Firstly, it ensures 'that expertise is available to facilitate the optimal usage of [the relevant] infrastructure' (capability survey response).

Several other responses to the survey of capability managers support this point:

> 'A critical weakness of most previous approaches to infrastructure development in Australia, focusing almost entirely on the provision of hardware, has been the lack of such technical support. At best this has led to the distraction of senior researchers into making up the shortfall in support, and at worst, significant inefficiency and waste through the inability to make full use of the physical infrastructure. In this regard the NCRIS program has been the most important development in research infrastructure support in many years.'
>
> 'Dedicated technical staff are employed to operate microarray and sequencing equipment and to provide a sample processing service. Sample

[77] p 61 in Allen Consulting, 2010.
[78] p 23-24 in Allen Consulting, 2010

> preparation for next-generation sequencing and microarray is critical as poor processing has a direct negative impact on the quality of the data output. It is therefore important that highly trained individuals process the samples. Furthermore, sample preparation is often a complex process requiring non-standard laboratory equipment. As a result of having highly trained individuals perform these assays, researchers receive the highest quality data and are able to perform assays that would otherwise not be possible in their own laboratories.'

A second benefit of NCRIS funding of technical staff is that it facilitates researchers accessing the relevant infrastructure. As a further capability survey response states, the 'ability for new users to enter a node and obtain experienced support and advice is central to ongoing user satisfaction and engagement.'

A layer of highly skilled technical staff is critical in many areas to enable a broad range of users to extract benefits from the facilities. In this context, it is worth noting that in many instances it is not practical to train individual users to an effective level in the use of specialist equipment, and thus such technical support roles are vital as a mechanism for providing quality access [79].

A third benefit of the funding of technical support was seen by many capabilities as being a broader benefit to Australia as a whole by building a skilled work-force with expertise in supporting major facilities.

Beyond NCRIS there are few examples of funding of operational costs alongside the capital costs of research infrastructure. Education Investment Fund (EIF) investments and infrastructure supported by the Super Science Initiative, for example, only provide funding for the creation and development of infrastructure, not associated operational costs. Stakeholders suggested that this inability to consider whole-of-life costs under EIF is likely to:

- reduce the utility of the infrastructure funded under EIF – Super Science Initiative; and
- reverse the cultural change engendered by NCRIS towards research infrastructure funding [80].

As one capability survey response states:

> 'Unfortunately, worrying trends are emerging from recent investments made in research infrastructure through the Education Investment Fund (EIF). Prime among these is that EIF investments seem no longer to be funding the

[79] p 31 in Science Panel Report, 2009
[80] p 41 in Allen Consulting, 2010

technical/scientific staff positions, but only the hardware ('stainless steel') of research infrastructure. Operational and support-staff costs must be core elements of such funding if the research infrastructure is to reach anything like its full potential, to keep Australian research competitive on the dynamic international stage and to provide good return on investment for science and innovation.'

'NCRIS has been a significant step forward in funding major Australian research infrastructure and has a sophistication of policy and implementation that was previously unseen. It will be a major backwards step for Australian research if the sophistication of policy and principles such as strategy, roadmaps, consultation, collaboration and the importance of funding operational and staff costs is lost due to financial or political drivers.'

It is clear that the research community feels that, because of the provision of funding for skilled staff and operational costs under NCRIS, the NCRIS investments are more likely to be cost-effective in the long run.

Key Finding:

The NCRIS program is cost-effective. Particular outcomes that contribute to its cost-effectiveness are:

- *a willingness to invest in human capital and operating costs, resulting in superior service delivery and viability of facilities;*
- *combined bargaining power, resulting in improved pricing; and*
- *leveraging of existing infrastructure and co-investment, resulting in investments of increased value.*

Meeting research infrastructure needs

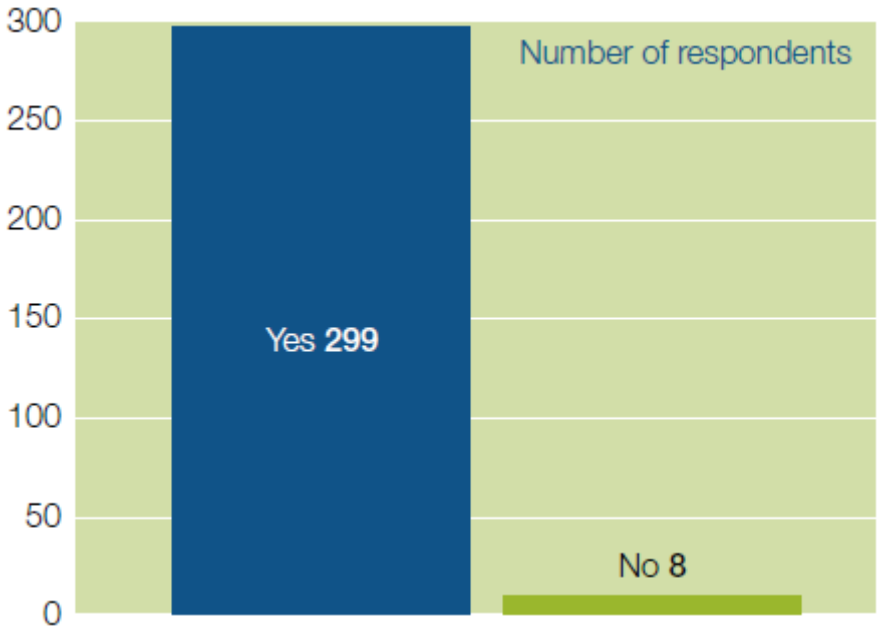
While support for any form of funding can be expected, strong support was expressed by capabilities and users for the fundamental structures of the NCRIS program, namely the strategic priority setting, the collaborative approach, the roadmapping process, the facilitation process to develop investment proposals, the focus on developing capabilities and the provision of funding for operating costs. A large majority of the respondents to the survey of NCRIS facility users reported that the facility they used had had a positive impact on their research[81] (**Figure 4**).

The NCRIS process involved identification of priority capabilities using a roadmapping process incorporating extensive community consultation, followed by the use of a facilitator to work projects up in conjunction with proponents. Because of

[81] p 60 in Allen Consulting, 2010.

this, there are no ‘failed’ applications for retrospective analysis. Infrastructure projects that did not receive support from the parties associated with a capability were generally not progressed within that capability. As the capability and user surveys did not elicit any requests for changes to this approach, the way NCRIS operates may be regarded as having wide acceptance in the community.

Figure 4 Has access to the facility had a positive impact on your research?



It would appear that, through its distinctive features, the NCRIS model is meeting many of the requirements for delivering an effective research infrastructure to support Australia’s research needs across the basic-strategic-applied research spectrum and it is seen as superior to preceding and other existing research infrastructure funding schemes. It is seen as providing one of the best opportunities for solving many of the national challenges of today and for tomorrow. It enjoys broad-based support from the researchers themselves, from university leaders, from agency/department representatives and from heads of funding agencies [82].

It should be noted that strong community support has been expressed for the NCRIS model for funding research infrastructure as distinct from support for funding per se. There has been under-investment in research infrastructure in the past, as recognised in Powering Ideas. There is still considerable unmet need for research infrastructure support in the Australian research sector, exemplified by the priority capabilities identified in the 2008 Roadmap not funded to date. The current NCRIS facilities do meet Australia’s research needs, but the view of the science community is that they are neither comprehensive nor exhaustive [83]. NCRIS does not purport to

[82] p 3 in Science Panel Report, 2009.
[83] p 11 in Science Panel Report, 2009.

be comprehensive in coverage, as for example, smaller infrastructure projects and extremely large projects are outside its remit.

Although the Super Science Initiative funding was welcomed by the research sector, there is also a need for funding for ongoing operational costs not met by this program.

Key Finding:

There is clear evidence the NCRIS program has been effective in meeting research infrastructure needs within the defined funding envelope. Whether this effect continues to be achieved will depend on whether the momentum gained by NCRIS can be maintained.

Case Study 5: Characterisation

To achieve the maximum effect in delivering high-quality research across as broad a set of disciplines as possible, expensive, complex equipment must be fully utilised and effectively deployed. In the absence of high-quality technical support, expensive equipment may underperform, not be used appropriately or be damaged by inexperienced users.

The NCRIS-funded Characterisation Capability embodies the concept of providing broad-based access to state-of-the-art equipment through national facilities (described below) where the equipment has been purchased with strategic intent and which enjoys high-quality technical support.

- The Australian Microscopy & Microanalysis Research Facility (AMMRF) is a national grid of equipment, instrumentation and expertise providing nanostructural characterisation capability and services to all areas of nanotechnology and biotechnology research. The AMMRF has captured novel developments in microscopy and microanalysis technology and has provided the essential ‘soft’ infrastructure and personnel to operate the infrastructure and ensure maximum use and outcomes.
- The National Deuteration Facility (NDF) offers the facilities, staff and expertise to produce molecules where all or part of the molecular hydrogen is in the form of deuterium. Hydrogen and deuterium scatter neutrons quite differently and so this enables scientists to use neutron scattering or Nuclear Magnetic Resonance (NMR) spectroscopy more effectively in the investigation of the relationship between the structure and function of proteins, DNA, synthetic polymers or other materials known as ‘soft matter’. The process of deuteration is highly specialised and time-consuming. Hence, NCRIS funding for staff who conduct this work is critical to both the capacity to obtain the desired molecules and to the development, maintenance and enhancement of the expertise needed for scientific success.

- The National Imaging Facility (NIF) provides imaging capability and capacity, both Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET), to researchers in biomedical and material sciences. NCRIS-funded Facility Fellows are a key component of the NIF. These are highly-skilled scientists who guide users in the appropriate technology, assist with experimental design, support the data analysis and provide advice regarding appropriate use of imaging to solve specific problems.

Efficiency

An evaluation of the efficiency of the NCRIS program was undertaken by considering whether, taking into account both short- and long-term economic and fiscal consequences, the NCRIS program has been administered and delivered in the most efficient way achievable.

Factors taken into account were the cost-effectiveness of the administration of the NCRIS program across the research sector, how much other parties contributed to the NCRIS investments and whether the program was implemented on schedule.

Efficiency of the NCRIS program administration

Australian Government efficiency

The Australian Government's administrative costs for NCRIS (i.e. total expenditure of $14.9 million), is equivalent to 2.7 per cent of the program funds (i.e. $542 million). A breakdown of these administrative costs is presented in **Appendix E, Table E3**. On a prima facie basis, this measure of efficiency suggests that the government's administration costs are proportionate to the outputs of the program. This judgment is supported by comparing the ratio of administration costs to funds distributed for NCRIS to other similar funding programs. For example, in 2008-09, the administrative costs of the ARC programs ($15.9 million) were equivalent to 2.7 per cent of total ARC funds distributed ($597.7 million), and in 2008-09, the administration costs of the NHMRC programs ($38.9 million) were equivalent to 3.8 per cent of total NHMRC funds distributed ($1,012.9 million) [84].

Another comparator program is the Cooperative Research Centre (CRC) program. Based on data provided by the department, in 2008-09 the administrative costs of the CRC program ($3 million) were equivalent to 1.6 per cent of total funds distributed ($182.8 million). It is possible, however, that this result may say less about the comparative efficiency of NCRIS and more about the mature and established nature

[84] p 28 in Allen Consulting, 2010.

of the CRC program. Details about government expenditure on the MNRF program are not available for comparison [85].

In addition to the quantitative data outlined above, qualitative evidence suggests that the Australian Government's administration has been efficient. In responses to the evaluation team, several capabilities pointed to the high level of constancy in key staff members at the department as a positive element of the program. One survey response stated:

> 'The MNRF section at DEST was quite passive, whereas the NCRIS Secretariat, though retaining appropriate independence of facility operations, has been much more engaged and involved with NCRIS facilities. This has also increased the efficiency of the NCRIS scheme as a whole.'

Government expenditure on NCRIS administration appears proportionate to the outputs of the program, especially in comparison with available data from other research funding programs. Feedback from relevant stakeholders also suggests that participant costs are appropriate relative to the perceived gains of the program [86].

The department advised that the NCRIS program was implemented on schedule and that all major milestones for establishing contracts and the delivery of funding were met. It has further advised that there was no significant rephasing of finance sought for the program. This evidence demonstrates that the program was implemented on schedule.

Efficiency of administrative procedures

The NCRIS program imposes administration costs on the capability areas involved. While the available quantitative data does not provide a clear picture of the efficiency of NCRIS in terms of participant costs, the available qualitative data suggests the program is efficiently administered. Capability stakeholders generally expressed satisfaction with the administrative processes and requirements of the NCRIS program. One indicative capability survey response stated:

> 'Reporting requirements are not onerous and in fact set a standard for strategic planning and reporting which helps define and monitor the direction of [the capability].'

Capability stakeholders also compared the administrative requirements of NCRIS favourably with those of other funding programs. A further survey response described NCRIS as:

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[85] p 29 in Allen Consulting, 2010
[86] p 25 in Allen Consulting, 2010

> ‘more efficient than many other infrastructure-funding schemes run by federal or state governments’.

NCRIS is particularly seen as being more efficient than its predecessor, the MNRF program. Another survey response stated:

> ‘The flexibility in both the yearly planning and reporting processes is an important element of this efficiency.’

Another example of efficiency, according to further survey response is:

> ‘that NCRIS allows much greater flexibility for facility planning, recognising that facilities will need to revise and hone plans during the course of the five-year program. The annual business plan provides a simple means to allow for changes in research needs, instrument acquisitions and timelines and so on.’

> **Key Finding:**
>
> *Taking into account government reporting requirements, the administration of the NCRIS program by the department has been efficient, with all funds contracted on schedule and with appropriate administrative costs for a complex program.*

Efficiency across the sector

Competitive and collaborative funding approaches impose different types of costs on government and participants. Under NCRIS, the strategic identification of priority capabilities, followed by the facilitation process, meant there were no unsuccessful ‘applications’ that incurred participant costs. The bulk of the costs associated with the roadmapping and facilitation processes were borne by the department and are included in the program administration costs. Even so, as noted above, the departmental administration costs for NCRIS are similar to other funding programs. Furthermore, overall community costs were reduced by the facilitated collaborative approach.

It should be noted that state and territory governments also incurred costs in the implementation of the NCRIS program, primarily through the roles they played in contributing to the roadmapping and facilitation processes and the processes associated with providing their own financial investments in NCRIS capabilities.

The key types of costs to government and participants are presented in **Table 3**[87].

[87] p 26 in Allen Consulting, 2010.

It is clear from capability interviews that there are several coordinators and participants within capabilities who are contributing a large amount of time and effort to support the collaborative model. Much of this time is provided 'in-kind' by researchers and capability staff enthusiastic about their capability, and is often over and above what is documented. This outcome sends a strong positive signal of support for the model from within the research community, and reflects the willingness of participants to support collaboration. That said, the value of this contribution needs to be recognised, and efforts made to ensure that it can be maintained into the future [88].

Table 3 Government and non-participant costs under funding programs[89]

Government costs under competitive funding programs:

- managing the application timetable (including promotion of key dates)
- receiving and processing applications (including initial eligibility checks)
- managing the peer review process (e.g. organising assessors, distributing applications and collating results)
- allocating funding to successful applicants
- notifying unsuccessful applicants and managing the appeals process
- ongoing oversight and reporting

Non-participant costs under competitive funding programs:

- compiling and submitting applications
- assessors dedicate their time to evaluating and ranking applications
- fulfilling reporting requirements under the funding agreement (e.g. providing progress reports, annual reports and other relevant documentation)

Government costs under NCRIS:

- managing the roadmapping process
- managing the facilitation process (primarily through the appointment of facilitators)
- evaluating the business and investment plans developed during the facilitation process and allocating funding accordingly

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[88] p 31 in Allen Consulting, 2010.

[89] Table 3 is presented as lists in this Word version for accessibility reasons. It is presented as table in the PDF version.

- ongoing oversight and reporting

Non-participant costs under NCIS:

- engaging with the roadmapping process (through consultations and/or submissions)
- engaging with the facilitation process
- fulfilling reporting requirements under the funding agreement (e.g. providing progress reports, annual reports and other relevant documentation)

Source: (Allen Consulting Group)[90]

Efficiency of capability governance

The NCRIS program is flexible in its approach to capability governance structures. The role of capability governance structures is to support the collaborative model and to ensure that capabilities meet their objectives relating to provision and management of research infrastructure. In the implementation phase each capability was able to choose the governance structure that best suited its needs.

There are relatively few governance models that could be used for NCRIS projects or for any future research infrastructure facilities:

- sole ownership by a lead institution, with agreed access arrangements;
- an unincorporated joint venture between several institutions, typically governed by a memorandum of understanding or similar documentation;
- incorporation as a not-for-profit association under the relevant State or Territory Associations Incorporation Act or equivalent; and
- incorporation under the Corporations Act 2001 either as a company limited by guarantee for bodies not intended to generate a profit, or limited by shares.

This evaluation did not uncover any evidence that any particular governance model was more or less appropriate for the program, but did receive some comment that capabilities had not been aware initially of the options available to them and how best to apply them. This suggests that a small investment in the development of guidance on the alternative governance options available, with some templates to help with the easier adoption of the chosen model, could produce efficiency gains for any future program based on the NCRIS model [91].

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[90] p 26 in Allen Consulting, 2010.
[91] p 31 in Allen Consulting, 2010

Key Finding:

Future programs for funding research infrastructure should consider providing more advice and guidance regarding suitable governance models.

Access and pricing

Access to research infrastructure on the basis of research merit is a key objective of the NCRIS program. The collaborative approach within capabilities has improved the accessibility of research infrastructure – both new infrastructure purchased with NCRIS funding and pre-existing infrastructure provided to capabilities on an in-kind basis by participants [92].

User fees for access to NCRIS facilities provide a contribution towards the infrastructure costs, particularly operating costs. However, data on fee revenue is not readily reported by capabilities. As part of this evaluation, the NCRIS facility user survey asked about the fees paid for access to the facility and whether the fees were an impediment to access. The access fees charged by facilities were not generally deemed to be an impediment to access, with 70.5 per cent of respondents answering that the access fees did not limit access to the facilities.

None of the respondents replied that access prices were excessive or inappropriate [93].

Greater transparency is needed around how access fees for infrastructure are charged, including documentation on the degree to which these reflect marginal cost. Access subsidies should be disclosed, and justified in terms of their contribution to Australia's scientific research effort [94].

The analysis of NCRIS funding did uncover inefficiencies in the access pricing regimes of the capabilities. Primarily, this related to the reluctance of capabilities to charge full or marginal cost, and the seeming lack of a consistent method to determine how access fees are applied in practice [95].

Although access fees are important for supporting the research infrastructure, there are issues around the extent to which access pricing affects genuine research. Too high a price discourages meritorious research, while too low a price leads to queuing, rationing and more stringent conditions for access [96].

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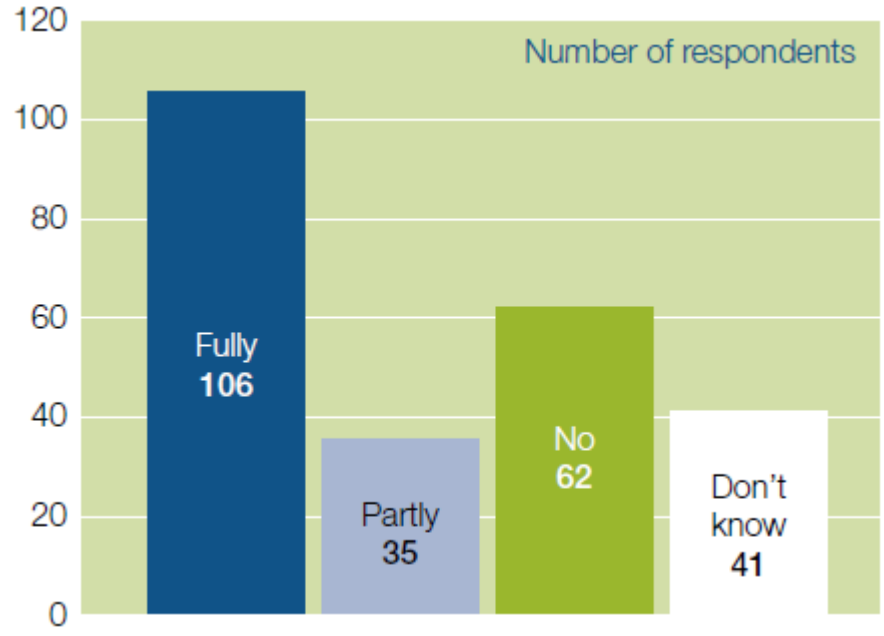
[92] p x in Allen Consulting, 2010.
[93] p 37 in Allen Consulting, 2010.
[94] p xiii in Allen Consulting, 2010.
[95] p 32 in Allen Consulting, 2010.
[96] p 36 in Allen Consulting, 2010.

Research grants as a source of funding for access fees

There is a need for greater alignment of ARC and NHMRC policies regarding the provision of funding for access fees in research grants and the needs of public users of research infrastructure facilities such as those funded under NCRIS. A significant proportion of NCRIS capabilities use an applicant's success in securing an ARC or NHMRC grant as a proxy for determining (either solely or in part) their merit as a researcher. In the NCRIS facility user survey, 58 per cent of users reported that their access costs had been met, either fully or partially, from grants [97] (see **Figure 5**). For those whose access costs were met from a grant, 38 per cent were funded by ARC, 19 per cent by NHMRC and 6 per cent by a CRC[98].

Despite the above figures, some stakeholders maintained that the ARC has not traditionally provided funding for elements of a grant application that explicitly requests funds for accessing NCRIS facilities [99]. The effectiveness of the NCRIS program would therefore be improved if ARC and NHMRC funding decisions reflected the availability of infrastructure accessible through NCRIS capabilities, and greater transparency of research costs and funding could be achieved where ARC and NHMRC grant funding incorporated the costs of accessing NCRIS infrastructure [100].

Figure 5 Is the cost of your access met from a grant?



[97] p 62 in Allen Consulting, 2010.
[98] p 62 in Allen Consulting, 2010.
[99] p 42 in Allen Consulting, 2010.
[100] p 57 in Allen Consulting, 2010.

Key Finding:

Greater transparency is needed around how access fees for infrastructure are charged, including improved rigor and documentation regarding the calculation and degree to which access fees reflect true marginal costs.

Access to research infrastructure needs to be paid for somewhere in the innovation system. Currently it is unclear where this responsibility lies. This issue should be addressed.

Integration

The evaluation considered the extent to which the NCRIS program has achieved integration by addressing whether, in the delivery of the NCRIS program, the government agencies involved are able to work together effectively to deliver the government's policy objectives consistently within clearly defined lines of responsibility.

Integration within and between governments

The NCRIS program is consistent with the government's policy objectives, and is generally compatible with other infrastructure programs. For the most part, NCRIS operates in a different space from other infrastructure programs and thus does not duplicate or impede their efforts. For example, NCRIS is primarily focused on the development and creation of infrastructure, whereas the RIBG Scheme is focused on the indirect costs associated with research grants. Likewise, NCRIS typically funds infrastructure projects of a larger scale than those funded under NHMRC infrastructure grants, ARC LIEF and most state government programs (see **Figure 1**).

ARC LIEF and NCRIS have different approaches to funding research infrastructure. The former allocates funding on a competitive basis, whereas a facilitated, collaborative process was used in the latter. Both these approaches have advantages. A collaborative approach, for instance, is well-suited for developing large, costly infrastructure where there are benefits for participants from pooling resources and avoiding duplication. A competitive approach is more suited for infrastructure where the potential benefits are likely to be limited to a particular institution or institutions and for the smaller pieces of equipment 'down the hall' that are used on a daily basis, and that each university should have itself [101]. In funding research infrastructure, government should aim to use competitive and collaborative approaches in a complementary manner [102].

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[101] Stakeholder feedback cited p 42 in Allen Consulting, 2010.
[102] p 42 in Allen Consulting, 2010.

Several state governments also have programs in place to fund the development of research infrastructure [103]. This is a complex area, and there is a need for governments and stakeholders to work together to avoid duplication or gaps arising from having funding provided by multiple jurisdictions. Managing the different time frames of Australian Government and state and territory budget processes will always be a challenge.

The science community regarded the close interactions between the Australian Government and state governments as having had a positive impact on infrastructure outcomes under the NCRIS program [104]. This was particularly the case where Australian Government coordination of the NCRIS program provided a useful impetus for state governments to develop arguments for increased funding for research infrastructure.

The states' involvement has resulted in:

- major co-investment by the states in many of the capabilities;
- closer science research collaboration between state and Australian Government agencies; and
- some states attaching a greater importance to high-level planning for R&D, and thus enhancing the impetus for R&D development within a state [105].

Facilitation between states and Australian Government agencies was seen to have been made considerably easier where there were pre-existing forums for discussing common issues. In South Australia the NCRIS developments are reported to have strongly supported the South Australian State Government's own agenda for collaboration and strategic investment in research infrastructure. It was reported that the state's agenda has not dominated, but has been responsive to the needs of the research community within the state. This was partly a reflection of the strong alignment between the state's strategic plan and framework for investment in research and the objectives of the strategic roadmaps [106]. A further example is provided in Victoria, where several co-investments in NCRIS Capabilities were made under the Science and Technology Innovation Initiative [107].

Integration between different components of the Australian Government was recognised as an important factor in the NCRIS program. The insistence on

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[103] p 40 in Allen Consulting, 2010.
[104] p 4 in Science Evaluation Panel, 2009.
[105] p 17 in Science Panel Report, 2009
[106] p 17 in Science Panel Report, 2009
[107] p 78 in Deloitte, 2009. *Impact Assessment of the Science and Technology and Innovation Initiative,* Department of Innovation, Industry and Regional Development.

collaboration within and across all boundaries has been seen almost universally as a strong beneficial aspect of the NCRIS process [108].

Various Australian Government agencies are involved in NCRIS Capabilities. For example CSIRO is involved in the Australian Animal Health Laboratory (AAHL) Collaborative Biosecurity Research Facility (ACBRF), the Australian Biosecurity Intelligence Network (ABIN), the Atlas of Living Australia, the Australian Microscopy and Microanalysis Research Facility (AMMRF), the Australian National Fabrication Facility, the Recombinant Proteins Facility, Optical and Radio Astronomy, AuScope, the Terrestrial Ecosystem Research Network (TERN), IMOS and Platforms for Collaboration. Geoscience Australia is a participant in AuScope. The Australian Nuclear Science and Technology Organisation (ANSTO) hosts the National Deuteration Facility (NDF) and managed the Australian Synchrotron Research Program (ASRP). The Department of Agriculture, Fisheries and Forestry is involved in an ABIN proof-of-concept project and the Royal Australian Navy and the Bureau of Meteorology are participants in IMOS. Further details of participants in NCRIS Capabilities are given in **Appendix E**.

An important factor in driving collaboration was the across-government support at the Commonwealth level for the program. No single Australian Government department was seen to be driving the program, or to have ownership of it, although it is administered by a single department [109].

Key Finding:

NCRIS appears to have been successful to date in engaging Australian Government, state and territory governments and government agencies on priority areas without compromising a national approach to funding research infrastructure.

Performance Assessment

The extent to which the NCRIS program has incorporated robust performance measurement was assessed by investigating whether the NCRIS program incorporates mechanisms for performance assessment and measurement in its delivery.

Capability performance assessment systems

Under the NCRIS program all capabilities provide performance reports, some of which are accessible by stakeholders online. At an aggregate level the NCRIS program meets its formal reporting requirements through the departmental annual

[108] p 10 in Science Panel Report, 2009.
[109] p 10-11 in Science Panel Report, 2009.

report mechanism. In some respects however, current processes for gathering and reporting performance information fall short of the objective of a robust performance measurement system. Areas of concern relate to:

- frameworks for assessing performance;
- the quality of indicators;
- accessibility of performance information; and
- user surveys [110].

Clearly this is an area where improvement is both possible and desirable.

An assessment of the adequacy of the key performance indicators (KPIs) of each capability revealed that, by and large, the indicators underpinning the performance assessment of NCRIS capabilities are adequate. However, there is some variation in the quality of the indicators across the capabilities. Some capabilities have clearly measurable KPIs with benchmarks, while other capabilities provide little information about the measurement or benchmark of their KPIs.

Ideally, the performance assessment frameworks of all the capabilities should share a common set of core outcomes. A framework for the development of performance indicators, with room for reporting against additional specific outcomes, was provided to each capability as an attachment to the funding agreement. However, there is some room for improving the development of a more consistent, benchmarked set of performance indicators for each capability and in the reporting of performance against these indicators.

Some capabilities have a large number of performance indicators. Current performance assessment processes for the program would be improved if NCRIS capabilities concentrated on gathering a few key indicators of performance, oriented around the extent to which facilities have contributed to research outcomes. This performance information should be aggregated on the NCRIS website. There is also value in capabilities sharing information on their systems and processes for performance assessment and reporting[111].

Key Finding:

Performance assessment for NCRIS capabilities is adequate, but could be improved by more consistent and benchmarked performance indicators across capabilities, and aggregation of performance data online.

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[110] p 43 in Allen Consulting, 2010.
[111] p 54 in Allen Consulting, 2010.

Strategic Policy Alignment

The extent to which the NCRIS program has achieved strategic policy alignment was investigated by examining whether the NCRIS program is consistent with the government's strategic long term policy priorities, in particular in areas that help sustain economic growth through improved productivity and participation.

As noted above, the Australian Government has expressed its support for the NCRIS program in *Powering Ideas*. However, the question here is broader and seeks comment on the effect of NCRIS on the economy. Comment on this is difficult, as NCRIS provides a broad, enabling component in the support of research. The economic impacts of NCRIS funding will, in some areas, be quite diffuse and difficult to measure. This may be because the research endeavour, such as astronomy, may not be motivated by economic aspects or because it is seeking to provide data that in part addresses broader government objectives, such as marine research and climate change, for which measurement in any given time frame may not be possible.

An important area where NCRIS has made a significant contribution to the economy, and where there is an ongoing requirement, is in the creation of jobs for skilled technicians to support research infrastructure.

The lack of a significant level of private sector funding of NCRIS facilities might be taken by some to indicate a lack of relevance to the economy, although such a view would also need to take into account utilisation patterns of NCRIS-funded research infrastructure. As regards this, too extensive use by private enterprise of NCRIS funded research infrastructure, particularly use that is aimed at commercial outcomes, would suggest that the facility was not providing sufficient access for publicly funded meritorious researchers.

The objective and principles of NCRIS are consistent with the Australian Government's reform agenda for the innovation system, *Powering Ideas*. A key objective of this agenda is for the Australian Government to renew and expand Australia's research capacity, particularly the country's research infrastructure.

Key Finding:

NCRIS is aligned with the Australian Government's broader policy objectives and with its programs. Future research infrastructure funding programs would need to ensure that this alignment is retained for previous and new programs.

Appendix A: Terms of Reference[112]

NCRIS Evaluation Terms of Reference

The evaluation terms of reference were developed in accordance with Department of Finance and Deregulation guidelines, particularly the Expenditure Review Principles.

In assessing government activity against the Expenditure Review Principles, evidence must be used to demonstrate whether the activity is the most appropriate, efficient and effective way to achieve the government's outcomes and objectives.

In addressing the terms of reference the evaluation will have regard to the NCRIS Principles, the NCRIS Objectives and the NCRIS Performance Indicators identified in the Evaluation Strategy. The terms of reference are summarised below.

Appropriateness

Provide an overview of the NCRIS program's appropriateness by addressing:

a The extent to which the NCRIS program has improved resource allocation compared with previous and alternative programs:

   i Is there a demonstrated need for the NCRIS as a government program?

   ii Is the NCRIS program consistent with current government policy?

   iii Is the NCRIS approach the best way to address the need for a national process to identify, prioritise and fund medium- to large-scale research infrastructure needs?

Effectiveness

Provide an overview of the effectiveness of the NCRIS program by addressing:

a Is the NCRIS program cost-effective?

b Do the NCRIS activities have clear and consistent objectives and are they effective in achieving their objectives. Do they represent value for money for the expenditure of taxpayer funds?

c What is the impact of the NCRIS program on research and how have research outcomes been improved? Specifically:

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[112] Full text of the Terms of Reference for the Evaluation, Economic Analysis and Science Panel, with supplementary questions and explanatory notes, can be accessed at http://ncris.innovation.gov.au/eval/Pages/default.aspx

i What has NCRIS provided?

ii Has NCRIS-funded infrastructure met research needs?

iii Is NCRIS-funded infrastructure world-class?

iv What type of collaborative arrangements has NCRIS enabled?

v To what extent has NCRIS fostered research activity that is collaborative and world-class?

vi Has the collaborative approach been effective?

Efficiency

Provide an overview of the efficiency of the NCRIS program by addressing:

a Is the NCRIS program administered and delivered in the most efficient way achievable?

b Taking into account both short- and long-term economic and fiscal consequences:

i Was the administration of the NCRIS program cost-effective across the research sector?

ii How much did other parties contribute to the NCRIS investments?

iii Was the program implemented on schedule?

Integration

Provide an overview of the extent to which the NCRIS program has achieved integration by addressing:

a In the delivery of the NCRIS program, are the government agencies involved able to work together effectively to consistently deliver the government's policy objectives within clearly defined lines of responsibility?

Performance Assessment

Provide an overview of the extent to which the NCRIS program has incorporated robust and performance measurement by addressing:

a Does the NCRIS program incorporate mechanisms for robust performance assessment and measurement in its delivery?

Strategic Policy Alignment

Comment on the extent to which the NCRIS program has achieved strategic policy alignment by addressing:

a Is the NCRIS program consistent with the government's strategic long term policy priorities, in particular in areas that help sustain economic growth through improved productivity and participation?

Science Panel Terms of Reference

Science and Research Panel Membership

A Science and Research Panel of three to four members, one of whom will be the Chair, will be appointed by the Department of Innovation, Industry, Science and Research, on the advice of the NCRIS Evaluation Team, to assist the Evaluation Team in the conduct of the evaluation of the NCRIS program. Members of the Science and Research Panel will be of international standing in a research field and able to comment broadly on research infrastructure across disciplines.

Science and Research Panel Role

The Science and Research Panel will prepare a report that describes their findings. The Evaluation Team will draw heavily from this report in the preparation of the Final Evaluation Report, in particular for those aspects that relate to the effectiveness of the NCRIS program.

The role of the Science and Research Panel will be to evaluate the research outcomes and the research impact of the infrastructure provided under NCRIS. The Panel will consider the effect of the NCRIS-funded infrastructure in terms of quality and the quantity of research outcomes resulting from the provision of this infrastructure.

Specifically, the Science and Research Panel will assist the Evaluation Team in preparing its response to Terms of Reference 5.1.2b and 5.1.2c.

Economic Consultant Terms of Reference

Economic Consultant

An independent consultant will be engaged by the Department of Innovation, Industry, Science and Research, on the advice of the NCRIS Evaluation Team, to provide an assessment of the economic and social impact of NCRIS-funded infrastructure investments. The consultant will also undertake an evaluation of the NCRIS Processes and Governance.

Economic Consultant Role

The Economic Consultant will prepare a report that describes its findings. The Evaluation Team will draw heavily from this report in the preparation of the Final Evaluation Report, in particular for those aspects that relate to the appropriateness, effectiveness, efficiency, integration and performance assessment of the NCRIS program.

The Economic Consultant will assist the Evaluation Team in formulating a response to the Terms of Reference 5.1.1a, 5.1.2a, 5.1.3a, 5.1.3b, 5.1.4 and 5.1.5.

Appendix B: NCRIS Evaluation Personnel

Evaluation Team Members[113]

Mr Barry Jones (Chair)
Head, Industry and Small Business Policy Division
Department of Innovation, Industry, Science and Research

Mr John Ryan PSM
Executive Director
Cloon Economics

Professor Edwina Cornish FTSE
Deputy Vice Chancellor (Research)
Monash University

Dr Alastair Robertson
Deputy Chief Executive, Science Strategy and Investment
CSIRO

Mr Michael Milligan
Director, Science and Innovation
Department of Further Education, Employment, Science and Technology
South Australian Government

Dr Phil McFadden FAA (in an advisory role)
Former NCRIS Committee member

Ms Anne-Marie Lansdown (in an advisory role)
Head, Science and Infrastructure Division
Department of Innovation, Industry, Science and Research

Science Panel Members

Professor Kurt Lambeck AO FAA FRS (Chair)
President, Australian Academy of Science
Distinguished Professor of Geophysics
Australian National University

Professor John Shine AO FAA
Executive Director, Garvan Institute of Medical Research
University of NSW

[113] In these appendices, personal titles and role descriptions refer to those held at the time of the relevant activity.

Professor Tanya Monro
School of Chemistry and Physics
University of Adelaide

Dr Mark Lonsdale
Chief, Division of Entomology
CSIRO

Economic Consultant

The Allen Consulting Group
Mr Stephen Bartos, Director
Dr John Bell FTSE, Associate Director
Ms Sharon Kennard, Project Manager

Appendix C: National Collaborative Research Infrastructure Strategy Advisory Council

Professor Rory Hume (Chair)
Former Vice-Chancellor and President, The University of New South Wales

Dr Michael Barber FAA
Executive Director, Science Planning
CSIRO

Dr Robin Batterham AO FREng FAA FTSE
The Chief Scientist of Australia

Professor Ian Chubb AC
Vice-Chancellor, Australian National University
(representing the Australian Vice-Chancellors' Committee)

Dr Phil McFadden FAA
Chief Scientist, Geoscience Australia
(representing the National Academies Forum);

Mr Peter Nissen
National Broadband Advisor for Education

Professor Alan Pettigrew
CEO, National Health and Medical Research Council

Dr Ian Smith
Chief Executive and Executive Director, Australian Nuclear Science and Technology Organisation

Dr Stephen Walker
Executive Director, Engineering and Environmental Sciences
Australian Research Council

Dr Evan Arthur PSM
Group Manager, Innovation and Research Systems Group
Department of Education, Science and Training

Mr Colin Walters
Group Manager, Science Group
Department of Education, Science and Training

Appendix D: NCRIS Committee

NCRIS Committee Terms of Reference

The NCRIS Committee advised the government on national research infrastructure strategy and priorities, including:

- priority areas of research for major infrastructure investment within the scope of the NCRIS funding program;
- infrastructure requirements for the national research and innovation system outside the scope of the NCRIS funding program, including the development of 'landmark' facilities and support for basic and institutional level infrastructure.
- coordination of infrastructure funding decisions with research funding agencies, across government and across levels of government;
- NCRIS funding allocation processes, including the development of program guidelines, and the implementation of NCRIS funded projects;
- progress in implementing NCRIS, including any barriers to effective implementation; and
- review of NCRIS funded projects and NCRIS in general.

NCRIS Committee Members

Dr Mike Sargent AM FTSE (Chair)
Director, MA Sargent and Associates Pty Ltd

Dr Evan Arthur PSM (until Nov 2007)
Group Manager, Innovation and Research Systems Group
Department of Education, Science and Training

Emeritus Professor David Beanland AO FTSE
Adjunct Professor, RMIT University

Professor Leanna Read FTSE (until Dec 06)
TGR BioSciences Pty Ltd

Dr Phil McFadden FAA
Chief Scientist, Geoscience Australia

Dr Roger Lough AM FTSE (until May 08)
Chief Scientist, Defence Science and Technology Organisation

NHMRC members

Professor Alan Pettigrew (until Dec 05)
Chief Executive Officer, National Health and Medical Research Council

Professor Warwick Anderson AM (from Feb 06)
Chief Executive Officer, National Health and Medical Research Council

ARC members

Dr Stephen Walker (to April 06)
Executive Director, Engineering and Environmental Sciences
Australian Research Council

Professor Peter Høj FTSE (May 06 until Apr 07)
Chief Executive Officer, Australian Research Council

Professor Margaret Sheil (from Oct 07)
Chief Executive Officer, Australian Research Council

Chief Scientist

Professor Jim Peacock AC FAA FRS FTSE (from May 06)
The Chief Scientist of Australia

NCRIS Committee Meetings and Outcomes

A summary of NCRIS Committee meetings, with key outcomes, is given below.

16 Sept 05	Finalisation of Terms of Reference and discussion of mechanisms for development of exposure draft of Strategic Roadmap. Agreed establishment of State and Territories Committee.
25 Oct 05	Discussion of consultation process for Strategic Roadmap development and agreed work plan.
15 Dec 05	Discussion of draft Strategic Roadmap and NCRIS implementation plan to be submitted to Minister.
28 Feb 06	Discussion of Investment Framework document, the facilitation process and the selection of facilitators.
28 Mar 06	Finalisation of facilitators, discussion of NCRIS funding envelopes, scoping for further capabilities and the NCRIS communication strategy.
2 May 06	Discussion of facilitators' progress reports, communication strategy, governance issues and report on NCRIS presentation to PMSEIC.

1 Jun 06	Discussion of facilitation updates, guidance to be provided on access and pricing, whole-of-life costs, coordination with ARC and NHMRC, NCRIS assessment processes and probity issues.
1 Aug 06	Consideration of facilitator progress reports.
29 Aug 06	Further review of investment plan progress. Consideration of request from Minister for landmark investment strategy.
19-20 Oct 06	Two-day meeting for facilitator presentations and consideration of investment plans for first set of nine capabilities. Development of recommendations for Minister.
19 Dec 06	Discussion of implementation strategy in response to Ministerial approval of NCRIS funding allocations. Discussion of method for progressing investment plans for remaining capabilities.
13 Apr 07	Consideration of investment plan for Platforms for Collaboration and the review of the roadmapping and facilitation processes.
3 Jul 07	Capability updates, consideration of Population Health Research Network, Terrestrial Ecosystems Research Network and further scoping for the Networked biosecurity framework capability.
5 Oct 07	Discussion of progress with Population Health Research Network, Networked biosecurity framework, Terrestrial Ecosystems Research Network and Platforms for Collaboration.
1 Feb 08	Minister Carr attends meeting. Discussion of revision of Strategic Roadmap, participation in the NIS Review and interactions with HEEF.
28 Feb 08	Discussion of review of Strategic Roadmap, participation in the NIS Review, project updates and revised Plant Phenomics Investment Plan.
28 Mar 08	Discussion of review of Strategic Roadmap, participation in the NIS Review, and Australian Biosecurity Intelligence Network Investment Plan.
26 May 08	Discussion of review of Strategic Roadmap with chairs of the Expert Working groups (Roadmap review), discussion of NIS Review with Professor Mary O’Kane.
27 Oct 08	Consideration of Terrestrial Ecosystems Research Network Investment Plan.

Appendix E: NCRIS Capabilities and Funding Tables

TABLE E1: General description of NCRIS capabilities[114]

Capability 5.1 Evolving biomolecular platforms and informatics

Bioplatforms Australia -Genomics

Description

Genomics Australia (GA) incorporates the Australian Genome Research Facility (AGRF) and a network of transcriptomics service providers under the banner of the Australian Transcriptomics Network. In addition, GA develops and optimises new tools to support the growing field of epigenomics, which focuses on a genome-wide approach to the study of the transmission of information from cell to cell not encoded in DNA sequences.

Genomics Australia provides integrated solutions across the core technologies of sequencing, genotyping, microarraying, bioinformatics, and agricultural genomics. The facility provides resources for the biological and biotechnological research spectrum, including biomedicine, animal and veterinary science, agriculture and microbiology.

Location/Participants

The AGRF has laboratories at: the University of Queensland; the Westmead Millennium Institute in Sydney; the Walter and Eliza Hall Institute for Medical Research (WEHI) in Melbourne; and the Waite Campus of the University of Adelaide. Other nodes of Genomics Australia are at: The Australian National University; CSIRO; The University of New South Wales; Southern Cross University; the University of Adelaide; the Victorian AgriBiosciences Centre; and the WA State Agricultural Biotechnology Centre.

Bioplatforms Australia –Proteomics

Description

Proteomics Australia (PA) builds on the Australian Proteome Analysis Facility (APAF) to create a national consortium of expert proteomics practitioners based on a hub-

[114] Table E-1 is presented as text in this Word version for accessibility reasons. It is presented as a table in the PDF version.

and-spokes organisational model to develop Australia's synergistic and complementary proteomics capabilities by providing both world-class infrastructure and services. PA also includes the newly established Monoclonal Antibody Technology Facility at Monash University that provides high quality monoclonal antibodies and support services using proprietary high-throughput technology.

Location/Participants

APAF is headquartered at Macquarie University, with nodes at the Universities of Sydney and NSW, and TGR Biosciences Pty Ltd in Adelaide. The other nodes of PA are at Monash University and the Queensland Institute of Medical Research.

Bioplatforms Australia –Metabolomics

Description

Metabolomics Australia (MA), based on a 'hub-and-spokes' organisational model, provides state-of-the-art metabolomics capabilities including sophisticated analytical facilities, man-power and expertise as well as high-throughput informatic solutions for metabolomics data analysis and interpretation. Metabolomics comprises the combination of high-throughput analytical technologies for the detection and quantification of metabolites in biological systems with the application of sophisticated bioinformatic tools for data mining and analysis.

Location/Participants

MA has nodes at: the University of Queensland; the University of Melbourne; the University of Western Australia; Murdoch University; and the Australian Wine Research Institute (South Australia).

Bioplatforms Australia –Bioinformatics

Description

The Australian Bioinformatics Facility (ABF) is delivering leading edge bioinformatics infrastructure, services and support to the other 'omics' platforms (genomics, proteomics and metabolomics) via coordinated use of shared resources. Specifically, the ABF is:

- jointly coordinating, with platform convenors, bioinformatics capabilities embedded in the 'omics' platforms;
- developing and providing high-level bioinformatics capabilities and services, including the storage, management, curation, integration and collaborative annotation of 'omic' data;

- ensuring best practice in bioinformatics and statistical analysis of ‘omic’ data, and the transfer of technology and skills into ‘omic’ bioinformatics; and
- establishing and consolidating links with major international bioinformatics centres and programs, including the hosting of mirrors of international databases and data sets.

Location/Participants

The ABF is hosted by Murdoch University.

European Molecular Laboratory (EMBL)

Description

The funding provides Australia’s contribution to associate membership of EMBL

Location/Participants

Participants in the Australian component of EMBL are Monash University, the University of Sydney, the University of Western Australia, the University of Queensland and CSIRO.

Capability 5.2 Integrated biological systems -

Australian Phenomics Network

Description

The Australian Phenomics Network (APN) provides access to technology for efficiently analysing perturbations in mammalian genes for their phenotypic effects. The research infrastructure takes the form of access to genetic variant mice, basic histology infrastructure and a mouse model archive. The APN is building the capacity to provide

- access to international sources of new mouse models and phenotype data derived from gene-trap embryonic stem cell collections
- access to N-ethyl-N-nitrosourea-mutagenised (ENU) libraries and histopathology phenotyping infrastructure
- archive and exchange services for mouse models as frozen sperm or embryos and the associated data management for capturing, annotating and disseminating information on mouse models and phenotypes.

Funding also supports the Integrated Biological Systems Steering Committee.

Location/Participants

The lead agent for the APN is the Australian National University. Participants include Monash University, the Walter and Eliza Hall Institute of Medical Research, the University of Melbourne, Victoria, the Centenary Institute, New South Wales; the Institute of Medical and Veterinary Sciences, South Australia, the Animal Resources Centre, Western Australia; the Queensland Institute of Medical Research and the Menzies Research Institute, Tasmania.

Australian Plant Phenomics Facility

Description

The Australian Plant Phenomics Facility (APPF) is a two node facility with a node in Adelaide and a node in Canberra. The APPF provides state-of-the-art capabilities for plant phenotyping (offering controlled environments, field-based plant growth monitoring, high-throughput robotics, automated imaging and computing technologies), integrated with the ongoing adaptation and application of emerging phenomics measurement technologies.

Location/Participants

The APPF comprises: the Plant Accelerator at the University of Adelaide's Waite Campus; and the High Resolution Plant Phenomics Centre at CSIRO Plant Industry and the Australian National University in Canberra.

Atlas of Living Australia

Description

The Atlas of Living Australia (ALA) is a unique informatics platform that underpins the Integrated biological systems capability. The ALA will be an authoritative, freely accessible, distributed and federated biodiversity data management system that links Australia's biological knowledge with its scientific reference collections and other custodians of biological information.

Location/Participants

CSIRO is the lead agent for the ALA. Other partners and participants include the Australian Museum; Museum Victoria; Queensland Museum; The Tasmanian Museum and Art Gallery; Southern Cross University; The University of Adelaide; the Council of Heads of Australasian Herbaria; the Council of Heads of Australasian Museum Directors; the Council of Heads of Australian Faunal Collections; the Council of Heads of Australian Entomological Collections; the Australian Microbial Resources Research Network, the Department of Agriculture, Fisheries and Forestry; and the Department of the Environment, Water, Heritage and the Arts.

Capability 5.3 Characterisation

Australian Microscopy and Microanalysis Research Facility

Description

The Australian Microscopy and Microanalysis Research Facility (AMMRF) has been established as Australia's leading facility for characterisation of matter down to the atomic scale by means of advanced microscopy and microanalysis. The AMMRF offers access to instrumentation including widely used optical, electron, X-ray and ion-beam techniques and state-of-the-art flagship platforms that form world-leading capabilities, such as pulsed-laser local-electrode atom probe, high-throughput cryo-electron tomography, high-resolution scanning electron microscopy and spectroscopy, and high-precision ion microprobes and spectroscopes.

The AMMRF offers a complete, modern suite of instruments accessible to all Australian publicly funded researches on a merit basis and at a nominal fee schedule. Industry-based researchers can also access the facilities for proprietary research at commercial rates.

Location/Participants

The AMMRF comprises nodes at: the University of Sydney, the University of New South Wales, the Australian National University; the University of Queensland (UQ); the University of Western Australia; and a consortium comprising the University of Adelaide, the University of South Australia, and Flinders University. In addition to the six major nodes, the AMMRF includes a Linked Centre at UQ's Australian Institute of Bioengineering and Nanotechnology, and Linked Laboratories at: RMIT University; Queensland University of Technology; Macquarie University; James Cook University; CSIRO Australian Animal Health Laboratory; and Curtin University of Technology.

National Imaging Facility

Description

The National Imaging Facility (NIF) provides state-of-the-art imaging of animals, plants and materials for the Australian research community. Specifically, the NIF provides:

- access to molecular imaging instrumentation, including a range of magnetic resonance imaging and positron emission tomography scanners;
- development and validation of novel biomarkers, radioligands and stable isotope-labelled analogues for in-vivo imaging using positron emission tomography (PET) and magnetic resonance imaging (MRI);

- development and application of new technologies such as magnetic resonance spectroscopy, coil design and pulse sequence development;
- bio-mathematical modelling, the creation of databases of normative data, and a common platform of base data; and
- links to existing national infrastructure for ultra-structural imaging and measurement technologies through the AMMRF.

Location/Participants

The NIF comprises nodes at: the University of Queensland; the University of Sydney; the University of New South Wales; the University of Western Sydney; the Florey Neuroscience Institutes; and the Large Animal Research and Imaging Facility, an unincorporated joint venture between the Institute of Medical and Veterinary Sciences and the Universities of Adelaide and South Australia.

National Deuteration Facility

Description

The National Deuteration Facility (NDF) is co-located with the neutron beam instruments at the OPAL reactor and the Bragg Institute – a centre for excellence in applications of neutron scattering at the Australian Nuclear Science and Technology Organisation (ANSTO). The NDF provides access to specialist laboratory space, equipment, staff and expertise to enable deuteration of biological and organic molecules for investigation using neutron scattering and other techniques, such as nuclear magnetic resonance spectroscopy.

Funding also supports the Characterisation Council.

Location/Participants

The NDF is located at the Australian Nuclear Science and Technology Organisation (ANSTO), New South Wales.

Australian Synchrotron

Description

NCRIS has contributed to the completion of the initial suite of 9 beamlines for the Australian Synchrotron. These beamlines are: High-throughput Protein Crystallography; Protein Microcrystal and Small Molecule X-ray Diffraction; Powder Diffraction; Small and Wide Angle Scattering; X-ray Absorption Spectroscopy; Soft X-ray Spectroscopy; Infrared Spectroscopy; Microspectroscopy; and Imaging and Therapy.

Location/Participants

The Australian Synchrotron is located at Clayton, Victoria.

Australian Synchrotron Research Program

Description

Under the NCRIS program funding was provided to the Australian Synchrotron Research Program (ASRP), which provides Australian researchers with access to state-of-the-art synchrotron radiation capabilities at three overseas synchrotron facilities. Access to these facilities supports Australian research in the areas of biotechnology, advanced materials, mineral processing, nanotechnology, information technology and communications.

Location/Participants

The ASRP was managed by ANSTO, New South Wales. The Facility uses the Photon Factory, Tsukuba Science City, Japan, the Taiwan National Synchrotron Radiation Research Centre and the Advanced Photon Source, Argonne National Laboratory, Chicago, USA.

International Synchrotron Access Program

Description

The International Synchrotron Access Program (ISAP) provides Australian researchers access to state-of-the-art synchrotron capabilities at overseas synchrotron facilities. Access to these facilities supports Australian research in the areas of biotechnology, advanced materials, mineral processing, nanotechnology, information technology and communications.

Location/Participants

The ISAP is managed by the Australian Synchrotron, Victoria. Australian researchers use facilities in the Asia/Oceanic region.

Capability 5.4 Fabrication

Australian National Fabrication Facility

Description

The Australian National Fabrication Facility (ANFF) provides Australian researchers with state-of-the-art fabrication capability for nanoparticles, nanostructures, nanosensors and nanotechnological devices. The capability provided by the ANFF enables researchers to process hard materials (metals, composites and ceramics)

and soft materials (polymers and polymer-biological moieties) and transform these into structures that have application in sensors, medical devices, nanophotonics and nanoelectronics.

Location/Participants

The ANFF is comprised of: the Melbourne Centre for Nanofabrication, a joint venture between Monash University, CSIRO, the University of Melbourne, RMIT University, La Trobe University, Swinburne University and Deakin University; the Australian National University; the University of Western Australia; the University of Wollongong; the University of Newcastle; Macquarie University; Bandwidth Foundry International; the University of Sydney; the University of Queensland; and the University of South Australia

Capability 5.5 Biotechnology products

Recombinant Proteins

Description

The goal of this project is to provide pre-commercial amounts of new therapeutic biological products with the appropriate support structures to foster Phase I and Phase II clinical trial activity that will allow Australia to bridge the gap between two of its most successful areas of research: drug discovery and clinical research. The project has developed three feeder nodes for process development for expression and purification of proteins, along with subsidised access to contract manufacturing organisations for the manufacture of proteins for clinical trialling.

Location/Participants

Feeder nodes are located at: the Australian Institute of Bioengineering and Nanotechnology (University of Queensland); the University of New South Wales; and a joint facility in Victoria operated by Monash University and CSIRO. Contract manufacturing providers are located at Hospira Adelaide Pty Ltd and Radpharm Scientific in Canberra.

Biofuels

Description

This project has supported two pilot plants for the development and demonstration of second-generation biofuels production from lignocellulosic and microalgae biomass, along with upgrades to research infrastructure at three universities to support research and development activities at the nodes.

Location/Participants

The lignocellulosics biomass refinery pilot plant is located at Mackay, Qld, and is owned and operated by the Queensland University of Technology. The microalgae photobioreactor pilot plant is located at Adelaide and is owned and operated by the South Australian Research and Development Institute. Fermentation, enzyme and hydrothermal liquefaction research facilities are located at the University of New South Wales, Macquarie University and the University of Sydney.

Manufacture of Human Cells for Transplant

Description

This project is facilitating access for researchers to facilities complaint with the code of Good Manufacturing Process (cGMP) for the growth and supply of human cells and cellular products for transplant, as well as supporting facilities to maintain licensing by the Therapeutic Goods Administration (TGA) and for others to become cGMP compliant and hence able to apply for TGA licensing.

Location/Participants

This facility is managed by Research Infrastructure Support Services (RISS) Pty Ltd. Currently participating facilities are located at the Peter MacCallum Cancer Centre, Victoria; Westmead Research Hub and Royal Prince Alfred Hospital, NSW; The Royal Perth Hospital and Orthocell, WA; the Mawson Institute, SA; the Institute of Medical and Veterinary Science, SA; and the Queensland Institute of Medical Research.

Capability 5.7 Population health and clinical data linkage

Population Health Research Network

Description

The Population Health Research Network (PHRN) will enable researchers in universities, research institutes, government agencies and other organisations to access: new and existing research datasets relevant to the health and wellbeing of the Australian population; ad hoc survey datasets; and routine administrative datasets. The PHRN infrastructure comprises a set of processes, methodologies, technologies and expertise. It includes: information and communication technologies (ICT) and ICT support; acquisition and maintenance of research equipment; workforce training, development and renewal; data management and data custodianship; analytical capacity; coordination among interested parties; and governance.

Location/Participants

Participating organisations include: the Telethon Institute for Child Health Research, Western Australia; Curtin University of Technology; Western Australian Department of Health; The Sax Institute, New South Wales; New South Wales Department of Health; New South Wales Office of Science and Medical Research; Department of Human Services, Victoria; the University of South Australia; the University of Adelaide; Flinders University; the Cancer Council of South Australia; the Motor Accident Commission (South Australia); South Australia's Department of Health and Department for Families and Communities; the Northern Territory Government; the University of Queensland; Queensland Health; the Menzies Research Institute, Tasmania; and the Tasmanian Department of Health and Human Services.

Capability 5.8 Networked biosecurity framework

Australian Biosecurity Intelligence Network

Description

The Australian Biosecurity Intelligence Network (ABIN) will be an information network and information exchange facility to provide Australian researchers with an online, collaborative and connected stakeholder workspace. ABIN aims to:

- create virtual web-delivered services that allow researchers and those involved in surveillance, preparedness and emergency responses in disparate environments to communicate and share data and knowledge across the network as if they were in a single environment.
- act as a repository for scientific knowledge and a resource for training; the expertise within ABIN to be made available, if desired, during times of emergency responses.
- develop appropriate analytical tools (e.g. modelling, epidemiological mapping, spatial analysis, etc) in support of biosecurity.

Location/Participants

Participating organisations include: CSIRO, Plant Health Australia Limited; Animal Health Australia Limited; Queensland Department of Primary Industries and Fisheries; and Northern Territory Department of Primary Industries and Fisheries and the Department of Agriculture, Fisheries and Forestry.

Australian Animal Health Laboratory

Description

As part of a comprehensive internal restructure and refurbishment of the Australian Animal Health Laboratory to overcome existing design limitations, NCRIS funds have

been used to create new, high-grade physical containment laboratories (PC3 and PC4) resulting in a considerable increase in useful laboratory space that will be better suited to contemporary biosecurity laboratory practices and national access for research groups working in shared space. In collaboration with the AMMRF, AAHL will also establish a specialist microscopy service specialising in the identification and characterisation of pathogens and infectious diseases.

Location/Participants

The Australian Animal Health Laboratory is located at Geelong, Victoria, and is managed by CSIRO.

Capability 5.10 Optical and radio astronomy

Astronomy Australia Ltd.

Description

The Optical and radio astronomy capability has three core objectives:

- enhancing the capability of Australia's only 4m-class optical/infra-red telescope, the Anglo-Australian Telescope (AAT);
- maintaining Australian access to 8m-class optical/infra-red telescopes; and
- investing in the development of the next generation of optical/infra-red and radio telescopes.

The objectives are being addressed through:

- the capital upgrade of the AAT, designed to ensure that Australian astronomers have access to a large number of nights on a highly productive 4m optical/infra-red telescope for the next decade;
- access for Australian researchers to international 8m-class telescopes that are currently the leading facilities at optical and infra-red wavelengths;
- participation in the design stage of a 25 metre-class telescope, the Giant Magellan Telescope (GMT);
- a design study for an optical telescope in Antarctica and support for infrastructure to participate in collaborations with US, Japanese and Chinese teams developing optical and Terahertz astronomy in Australia; and
- funding support of the development of the Australian SKA Pathfinder (ASKAP) and the Murchison Widefield Array (MWA) radio telescopes.

Location/Participants

Participating organisations include: Astronomy Australia Limited; CSIRO; Curtin University of Technology; the Australian National University; the University of New South Wales; and the Anglo-Australian Telescope Board.

Capability 5.11 Terrestrial ecosystem research network

Terrestrial Ecosystem Research Network

Description

The objective of the Terrestrial Ecosystem Research Network (TERN) facility is to provide a set of dedicated observation sites; standardised measurement methodologies; equipment and data; and information services that collectively will contribute to meeting the needs of terrestrial ecosystem research and natural resource management in Australia for observing and monitoring data related to terrestrial ecosystems and potentially coastal ecosystems. The following TERN facilities have been established:

- the Australian Centre for Ecological Analysis and Synthesis (ACEAS) to provide a virtual and physical environment for interdisciplinary integration, synthesis planning and modelling;
- an Eco-informatics capability to provide a single framework for data and information management and discovery of Australian ecosystem data;
- a Distributed Archive and Access Capability for Australian Biophysical Map Products and Remote Sensing Data (AusCover DAAC) to provide a federated national terrestrial remote sensing data and information service;
- the National Scientific Reference Site Network (Australian Rangeland Ecosystems) to establish a national network of scientific reference sites across the Australian Rangelands and related ecotones;
- the Australian National Flux Network builds upon the current OzFlux (managed by the CSIRO and other key organisations) network to establish a national network of flux sites; and
- two Super-Site Network Demonstrators: the Peri-Urban Coastal Node in South East Queensland and the Rainforest Biodiversity Node in Far North Queensland (funded by the Queensland State Government by a $4.1 million investment) to link specific site-based observations to regional and then continental-scale models.

Location/Participants

Participants in TERN include: the University of Queensland; Griffith University; Queensland University of Technology; Qld Dept of Environment and Resource Management; CSIRO; the University of Adelaide; SA Dept for Environment and Heritage; the Bureau of Meteorology; Charles Darwin University; Commonwealth Dept of Agriculture, Fisheries and Forestry; Curtin University of Technology; Geoscience Australia; James Cook University; La Trobe University; Monash University; the University of Sydney; the University of Tasmania; and the University of Technology, Sydney.

Capability 5.12 Integrated marine observing system

Integrated Marine Observing System

Description

The Integrated Marine Observing System (IMOS) facility consists of:

- Argo Australia - ocean monitoring with autonomous profiling floats;
- Ships of Opportunity - collection of a wide range of marine data using instrumentation fitted to a variety of ships including the RVs Southern Surveyor, Aurora Australis, Cape Ferguson and Solander;
- Southern Ocean Automated Time Series Observations - deployment of moored instruments for time-series observations of physical, biological, and chemical properties;
- the Australian National Facility for Ocean Gliders - deployment of gliders operating in both shelf/slope waters and in the open ocean to acquire measurements of physical, chemical and biological properties;
- the Autonomous Underwater Vehicle (AUV) Facility - deepwater AUVs made available to the wider marine science community;
- the Australian National Mooring Network - a series of national long-term reference stations and regional moorings monitoring oceanographic phenomena in coastal ocean waters;
- the Australian Coastal Ocean Radar Network - a coordinated network of high-frequency radars for observation of coastal currents and waves;
- the Australian Acoustic Tagging and Monitoring System - an array of submerged receiving stations to complement the Ocean Tracking Network Facility for Automated Intelligent Monitoring of Marine Systems sensor networks to provide data to enable understanding of complex marine processes; and

- the eMarine Information Infrastructure to provide a single integrative framework for data and information management.

Location/Description

IMOS participants include: the University of Tasmania; CSIRO; Australian Institute of Marine Science; Bureau of Meteorology; Australian Government Antarctic Division; Geoscience Australia; Royal Australian Navy; Antarctic Climate and Ecosystems CRC; Scripps Institute of Oceanography; the University of Western Australia; Curtin University of Technology; Defence Science and Technology Organisation; James Cook University; Tropical Marine Network; Queensland Cyber-Infrastructure Foundation; Queensland Department of Employment, Economic Development and Innovation. the University of Melbourne; Flinders University; South Australian Research and Development Institute; SA Dept of Further Education, Employment, Science and Technology; Sydney Harbour Institute of Marine Science; Sydney Water; Manly Hydraulics Laboratory; NSW Dept of Environment and Conservation; NSW Dept of Primary Industries; and the Ocean Tracking Network.

Southern Surveyor

Description

Funding was provided for repair and maintenance of the Southern Surveyor.

Location/Participants

The Southern Surveyor is managed by the Marine National Facility.

Capability 5.13 Structure and evolution of the Australian continent

AuScope

Description

The AuScope Infrastructure system is a seamless, broadly accessible, fully integrated blend of technology, data and knowledge infrastructure that will transform the practice of and outcomes from geoscience for researchers, industry and the wider community. It consists of the following components:

- Earth Imaging and Structure capability for identification of subsurface structure on local, regional and continental scales;
- the Virtual Core Library for determination of the mineralogy of the upper 1km of Australian continent by spectroscopic analysis of existing and future drill core samples;

- the Earth Composition and Evolution capability to support the study of formation mechanisms and time context of the components constituting the Australian continent through the provision of new geochemical instrumentation, improved access to existing infrastructure, and a national data management and delivery network;
- Geospatial Very Long Baseline Interferometry to define the scale and orientation of the Australian geodetic reference frame;
- Geospatial Gravity measurement capabiltiy to provide the necessary link between the Cartesian coordinate system and the dynamic height system defined by level surfaces;
- Geospatial Satellite Laser Ranging and Global Navigation Satellite Systems to support the geodetic reference frame and accurate modelling of reference frame deformation. New sites will also incorporate meteorological stations to aid atmospheric studies;
- the AuScope Grid - distributed data storage hardware, high-bandwidth network links, data management protocols, middleware and software (to be built and maintained in conjunction with Platforms for Collaboration capability);
- the AuScope Simulator - a toolkit of simulation, modelling, inversion and data-mining tools underpinned by parameters provided by the AuScope Earth Composition and Evolution component.

Location/Participants

AuScope participants include: the Australian National University; Curtin University of Technology; Macquarie University; Monash University; University of Adelaide; University of Melbourne; University of Queensland; University of Sydney; University of Tasmania; University of Western Australia; CSIRO; Geoscience Australia; Geoscience Victoria; Geological Survey of Queensland; Geological Survey of Western Australia (Landgate); Geological Survey of New South Wales; Mineral Resources Tasmania; the Northern Territory Department of Planning, Infrastructure and Environment; the Northern Territory Department of Primary Industries, Fisheries and Mines; Primary Industries and Resources South Australia; and the National Aeronautics and Space Administration (NASA).

Capability 5.16 Platforms for Collaboration

Description

The Platforms for Collaboration investment supports technological platforms that enhance researchers' ability to generate, collect, share, analyse, store and retrieve information, allowing them to access knowledge, data and information and work

together seamlessly from desk to desk between organisations. The investment supports the following:

- the National Computational Infrastructure (NCI) project delivers an internationally significant high-performance computing (HPC) capability, services and infrastructure assigned on a merit and priority basis, and builds essential expertise in HPC needed to support priority research and is also providing a national strategy for computation infrastructure;
- the Interoperation and Collaboration Infrastructure (ICI) project provides grid enabled technologies and infrastructure to enable seamless access to research facilities and services and supports collaborative projects undertaken through a joint-venture known as the Australian Research Collaboration Service (ARCS);
- the Australian National Data Service (ANDS) project provides a systemic approach to research data to transform the disparate collections of research data around Australia into a cohesive corpus of research resources, ensuring researchers are able to identify, locate, access and analyse any available research data;
- the Australian eResearch Infrastructure Council (AeRIC), which is the governance and coordination body within the PfC capability responsible for ensuring that world-class infrastructure, services and expertise are identified, developed and delivered nationwide in ways that sustain the strategic motivation and promotion of eResearch; and
- the National eResearch Architecture Taskforce (NeAT), which has been established to provide guidance on the evolution of the national eResearch infrastructure and to identify and scope activities that broaden the appeal of eResearch services.

Location/Participants

Platforms for Collaboration participants include: the Australian National University; the Australian Synchrotron; the Bureau of Meteorology; Geoscience Australia; Monash University; CSIRO; the Queensland Cyber Infrastructure Foundation; the University of Queensland; Intersect Australia; the Victorian Partnership for Advanced Computing; iVEC, Western Australia; eResearch South Australia; the Tasmanian Partnership of Advanced Computing; the University of Tasmania; the Centre for Australian Weather and Climate Research; the Swinburne University Centre for Astrophysics and Supercomputing; and the Australian Centre for Advanced Computing and Communication Pty Ltd

TABLE E2: Funding for NCRIS capability facilities[115]

	NCRIS TOTAL $	Cash Co-investment $	In-Kind Co-investment $	TOTAL Co-investment $	TOTAL Funding $
5.1 Evolving biomolecular platforms and informatics - Bioplatforms Australia Ltd	50,000,000	30,473,800	58,247,600	88,721,400	138,721,400
5.1 Evolving biomolecular platforms and informatics - European Molecular Biology Laboratory	3,000,000	5,000,000	0	0	8,000,000
5.2 Integrated biological systems - Atlas of Living Australia	8,233,000	8,212,500	18,340,755	26,553,255	34,786,255
5.2 Integrated biological systems - Australian Phenomics Network (includes allocation for Integrated Biological Systems Steering Committee)	16,034,000	21,777,307	14,124,721	35,902,028	51,936,028

[115] These figures represent NCRIS funds that have been contracted by 18 May 2010. A further $15,060,000 was allocated in 2005-2006 and 2006-2007 to direct investments into selected research infrastructure projects and to provide additional support for selected MNRF facilities pending the full rollout of the NCRIS program. Funding of $14,948,939 was used for running costs (see Table E3). The remaining funding is yet to be contracted, but all $542 million has been committed.

	NCRIS TOTAL $	Cash Co-investment $	In-Kind Co-investment $	TOTAL Co-investment $	TOTAL Funding $
5.2 Integrated biological systems - Australian Plant Phenomics Facility	15,243,000	24,986,500	8,420,654	33,407,154	48,650,154
5.3 Characterisation - National Imaging Facility	7,250,000	13,650,500	875,000	14,525,500	21,775,500
5.3 Characterisation - National Deuteration Facility (includes allocation for Characterisation Council)	3,525,000	0	4,108,000	4,108,000	7,633,000
5.3 Characterisation - Australian Microscopy and Microanalysis Research Facility	19,102,500	24,510,000	25,487,521	49,997,521	69,100,021
5.3 Characterisation - Australian Synchrotron - beamlines	13,910,000	50,000,000	0	50,000,000	63,910,000
5.3 Characterisation - Australian Synchrotron Research Program (ASRP) – access to international facilities	3,570,000	0	0	0	3,570,000
5.3 Characterisation - International Synchrotron Access Program (ISAP)	629,500	0	0	0	629,500
5.4 Fabrication - Australian National Fabrication	41,000,0	49,700,000	45,850,000	95,550,000	136,550,000

	NCRIS TOTAL $	Cash Co-investment $	In-Kind Co-investment $	TOTAL Co-investment $	TOTAL Funding $
Facility Ltd	00				
5.5 Biotechnology products - Recombinant Proteins and Biofuels	21,380,000	28,220,000	7,447,000	35,667,000	57,047,000
5.5 Biotechnology products - Manufacture of Human Cells for Transplant	7,620,000	6,975,000	0	6,975,000	14,595,000
5.7 Population health and clinical data linkage - Population Health Research Network	20,000,000	9,928,000	21,886,000	31,814,000	51,814,000
5.8 Networked biosecurity framework - Australian Biosecurity Intelligence Network116	16,115,000	0	3,853,024	3,853,024	19,968,024.00
5.8 Networked biosecurity framework - Australian Animal Health Laboratory	8,500,000	0	2,575,000	2,575,000	11,075,000
5.10 Optical and radio astronomy - Astronomy Australia Ltd	45,531,000	5,537,000	9,212,000	14,749,000	60,280,000

[116] Co-investments reflect currently contracted amounts – this is likely to increase as further subcontracts are put in place.

	NCRIS TOTAL $	Cash Co-investment $	In-Kind Co-investment $	TOTAL Co-investment $	TOTAL Funding $
5.11 Terrestrial ecosystem research network - Terrestrial Ecosystem Research Network	20,000,000	8,265,000	28,220,000	36,485,000	56,485,000
5.12 Integrated marine observing system - Integrated Marine Observing System	50,000,000	16,864,000	24,647,000	41,511,000	91,511,000
5.13 Structure and evolution of the Australian continent - AuScope	42,800,000	33,475,648	51,424,230	84,899,878	127,699,878
5.16 Platforms for Collaboration - National Computational Infrastructure (NCI),	26,000,000	17,500,000[117]	11,000,000	28,500,000	108,455,012
5.16 Platforms for Collaboration - Interoperation and Collaboration Infrastructure (ICI) – ARCS	20,500,000				
5.16 Platforms for Collaboration - Australian National Data Service (ANDS)	24,000,000				
5.16 Platforms for Collaboration - Authorisation Services, Australian Social Science Data Archive	9,455,012				

[117] Co-investments are across the whole Platforms for Collaboration capability.

	NCRIS TOTAL $	Cash Co-investment $	In-Kind Co-investment $	TOTAL Co-investment $	TOTAL Funding $
(ASSDA) Services for eSocial Science (ASeSS), AeRIC and Research Networks in the Northern Territory.					
TOTAL	500,098,012	355,071,755	335,718,505	685,790,360	1,190,888,372

Table E3: NCRIS Program Administration Costs – Australian Government[118]

	Actual 2005-06	Actual 2006-07	Actual 2007-08	Actual 2008-09	Expected 2009-10	Expected 2010-11	Total
Departmental -Average Staffing Levels (Allocated)	13.5	15.6	15.8	15.4	15	15	90.3
Salaries	1,405,619	1,631,189	1,654,321	1,601,579	1,637,978	1,670,738	9,601,424
Non-Salary	195,511	184,589	152,856	238,000	238,000	238,000	1,246,956
Sub-total Departmental	1,601,130	1,815,778	1,807,177	1,839,579	1,875,978	1,908,738	10,848,380
Total NCRIS Committee	69,002	118,294	91,545	41,438	3,000		323,279
Total Consultants/ Contractors	134,027	23,352	64,078	80,682	236,682		538,821
Sub-total Consultants	203,029	141,646	155,623	122,120	239,682		862,100
Facilitators 1st Group - Evolving biomolecular platforms	100,000	108,967					208,967
Facilitators 1st Group - Integrated biological systems	100,000	132,484					232,484
Facilitators 1st Group - Characterisation	100,000	161,852					261,852
Facilitators 1st Group - Fabrication	100,000	100,000					200,000
Facilitators 1st Group - Biotechnology products	73,182	63,343					136,525
Facilitators 1st Group - Networked	100,000	131,113					231,113

[118] Staffing levels for 2009-2010 and 2010-2011 are estimates only. Research Infrastructure staff are employed on the development and implementation of EIF and Super Science infrastructure projects, and not just on NCRIS infrastructure projects, therefore these figures are overestimates for NCRIS program support. These estimates have been revised since they were provided to Allen Consulting.

biosecurity framework							
Facilitators 1st Group - Optical and radio astronomy	70,000	130,927					200,927
Facilitators 1st Group - Integrated marine observing system	100,000	84,336					184,336
Facilitators 1st Group - Structure and evolution of the Australian continent	100,000	180,000					280,000
Facilitators 1st Group - Platforms for collaboration	100,000	150,000	40,920				290,920
Facilitators 2nd Group - Population health and clinical data linkage			175,000	121,606			296,606
Facilitators 2nd Group - Terrestrial ecosystem research network		250,000	70,387	103,909			424,296
Scoping - 2nd Group - Population health and clinical data linkage		5,482					5,482
Scoping - 2nd Group - Terrestrial ecosystems research network		12,454					12,454
Additional Scoping - Networked biosecurity framework			272,497				272,497
Sub - Total Facilitators	943,182	1,510,958	558,804	225,515			3,238,459
Total Running Costs	**2,747,341**	**3,468,382**	**2,521,604**	**2,187,214**	**2,115,660**	**1,908,738**	14,948,939

References

Australian Bureau of Statistics, October 2008. Research and Experimental Development, All Sector Summary, Australia, 2006-07. http://www.abs.gov.au/ausstats/abs@.nsf/mf/8112.0

Batterham, R. and Department of Industry, Science and Resources, August 2000. The Chance to Change Discussion Paper by the Chief Scientist.

Deloitte, October 2009. Impact Assessment of the Science and Technology and Innovation Initiative, Department of Innovation, Industry and Regional Development.

Department of Education, Science and Training, November 2003. Research Infrastructure. Mapping Australian Science and Innovation Background Paper.

Department of Education, Science and Training, March 2004. The Final Report of the National Research Infrastructure Taskforce.

Department of Education, Science and Training, July 2005. National Collaborative Research Infrastructure Strategy (NCRIS) Advisory Committee Implementation Advice.

Department of Education, Science and Training, 2005. List of Major Australian Research Infrastructure. Department of Education, Science and Training, February 2006. National Collaborative Research Infrastructure Strategy Strategic Roadmap. Department of Education Science and Training, April 2006. Investment Framework

Department of Education Science and Training, April 2007. Review of NCRIS Roadmap and Facilitation Processes.

Department of Innovation, Industry, Science and Research, August 2008. Venturous Australia – building strength in innovation.

Department of Innovation, Industry, Science and Research, August 2008. Strategic Roadmap for Australian Research Infrastructure

Department of Innovation, Industry, Science and Research, May 2009. Powering Ideas: an innovation agenda for the 21st century.

Department of Innovation, Industry, Science and Research, September 2009. Investment Framework v2.

Innovation Summit Implementation Group, August 2000. Innovation: Unlocking the Future.

Organisation for Economic Cooperation and Development, 2007. Innovation and Growth Rationale for an Innovation Strategy.

Productivity Commission, 2007. Public Support for Science and Innovation.

Science Evaluation Panel, December 2009. Report from Science Panel for NCRIS Evaluation Team.

The Allen Consulting Group, January 2010. Evaluation of the National Collaborative Research Infrastructure Strategy Economic Analysis.