



Conversations for change.
eResearch challenges
in New Zealand

eResearch 2020

Abridged
Discussion Document
March 2015

eResearch 2020

eResearch 2020 is a 12 month qualitative study launched by NeSI, REANZ and NZGL in 2014. We spoke with researchers across a wide range of disciplines, as well as leaders of ICT and management at our research institutions. In each case we asked them to discuss the potential for change in their work over the coming decade, and to highlight the opportunities and challenges they see before us as a national research system.

REANZ



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High-quality science and innovation can have a transformational effect on a nation. Research and development investment offers the power to increase economic productivity and competitiveness and improve health, social and environmental outcomes in unprecedented ways.

Indeed, New Zealand’s economic and social wellbeing depends on the productivity and competitiveness of our economy and the *knowledge* we have to help make informed decisions as a society. Science provides that knowledge and informs those decisions.

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Introduction: the future of research is digital . . .

The distinction between “Research” and “eResearch” is disappearing. The skills expected of a few, select, data, ICT, or eResearch groups are diffusing into the wider research sector at a greater pace than ever.

Over the last few years, international research norms have begun a shift to digitally driven research methods and to new standards in terms of evidence and publishing. The future impact of New Zealand research and researchers will depend on the ability of the sector to adopt these new tools and to excel against the new expectations.

“We’re only doing things in half measures, such as funding National Science Challenges without thinking about what support structures are necessary. NZ needs a coordinated eResearch ecosystem — it needs a comprehensive science data policy, appropriate governance, incentives for institutions to invest in data infrastructure, a willingness to develop data-intensive research skills over a long period of time, and a relentless focus on quality.”

To address this we need a coordinated approach across the research sector. Most importantly we need to alter the culture in our research institutions towards quality engagement with digital research methods and 21st century standards.

eResearch 2020 is a future oriented, national conversation that aims to assemble a comprehensive vision of researcher needs and essential skills over the coming decade. eResearch 2020 is led by NeSI, REANNZ and NZGL as co-patrons.

“NZ likes to do per capita calculations to show how good we are or how we manage our investments, but a comparative per capita measure is the wrong approach in this area for such a small country — it is leading us to under-invest.

Small nations, particularly those in Scandinavia (and elsewhere too) are investing substantially more — and more diversely, that is in basic sciences as opposed to a focus on applied science. It’s not because they want to, or they love scientists and engineers, but they see they have to in order to build the science based research ecosystems necessary to underpin any successful economy in the future.

To make the point, a comparative per capita approach to making infrastructure investments simply would not be affordable for China — and would inevitably lead to over-investment. China has to use a different measure to be able invest at appropriate levels for their economy — and so must we.”

Four key observations of eResearch 2020

1

SKILLS LAG:

We are under-investing in research skills and methodological training.

2

RESEARCH COMMUNITIES:

eResearch strategy needs to fit with the needs of different research-disciplines.

3

ALIGN INCENTIVES:

Research and institutional planning need to be better aligned.

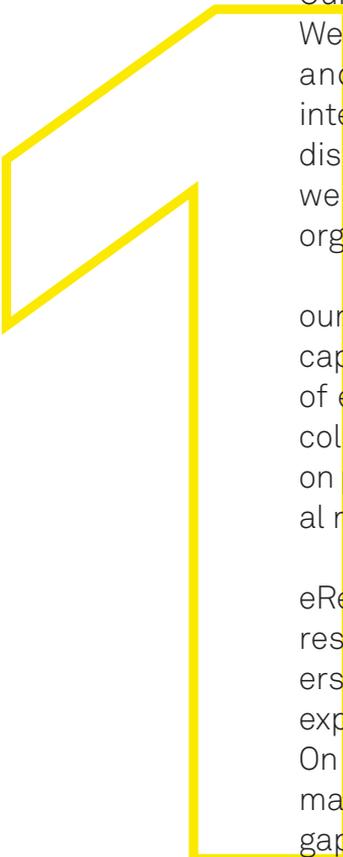
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FUTURE INFRASTRUCTURE:

We must prioritise investment in data, visualisation, and digital research expertise.

SKILLS LAG

Ensure researchers keep up with the pace of change



Our researchers are not keeping up with the pace of change. We are under-investing in the broad-based research skills and methodological training that underpins the shift internationally towards digital evidence and data intensive discovery. The major capital and programme investments we have made are disconnected, either geographically or organisationally.

Consequently we are putting at risk the quality of our research outputs and our opportunity to grow high tech capabilities in the country, today and into the future. A lack of engagement with new methods may limit our ability to collaborate internationally, which will have flow on effects on publishing impactful research and accessing international research funding.

The lag in engaging with digitally driven methods and eResearch skills has critical implications. As more and more research activity moves into the digital domain, researchers are struggling to keep up with changing standards and expectations within their international research community. On one hand we struggle to grasp meaning from all the information we are collecting, while on the other we see a growing gap in funding mechanisms for data infrastructure.

Key areas where researchers and research institutions need to lift their game include:

___ **REPRODUCIBILITY:** much of our research output is not sufficiently reproducible.

___ **LONG TERM SUSTAINABILITY OF DATA/EVIDENCE:** we lack support for storing and managing data beyond the end of the research project that generated it.

___ **STANDARDISED TOOLSETS FOR RESEARCH DISCIPLINES:** our graduates need to emerge from university already equipped with digital skills, tools and standards accepted and applied in the fields they are entering.

___ **RESEARCH METHODOLOGY. FLOW INTO ECONOMY AND SOCIETY:** our researchers and research institutions need to be able to lead the way in terms of methods and practice.

RESEARCH COMMUNITIES

Design research infrastructure around users

Our approach to infrastructure has usually been centered on investment with research institutions, yet researchers and research are often better connected within discipline-centric research communities, rather than at an institutional level. Greater explicit investment support for research-discipline led collaboration is likely to lead to greater cohesion, knowledge exchange, and collaborative research outcomes across the system — and perhaps better uptake of shared infrastructure and services.

There is arguably a gap in explicit funding for collaborative, inter-discipline endeavour. Possibly the most impactful links for collaboration and impact in science occur at the “research-discipline community” level, within and across groups of researchers who share a research domain or discipline, rather than within an institution or a locale. This suggests that mechanisms which promote connectivity, knowledge sharing and cohesiveness within research disciplines, yet on a national scale, will better impact quality, collaboration, and the pace of progress.

The argument for designing research infrastructure, and in particular research data infrastructure, around particular research communities, follows from the observation that evidence, practice, and collaboration in research dif-





Small countries still have big problems; we can't rely on *small science* to solve them. For example, to be at the leading edge in dairy genomics is an economic necessity for New Zealand. A small percentage difference in growing grass, or dairy nutrition, or milk production all have major impact on our comparative advantage and economic fortunes in the global economy.

For NZ, genomics is an essential eResearch, compute driven discipline. If we take a backseat in the science, then we are really taking a backseat in economic development and global competitiveness.

fers from discipline to discipline. To be adopted and become embedded, research and data infrastructure in New Zealand needs to fit both the digital technology maturity of the research community concerned, and the particular data and meta-data standards of that research discipline.

In making investment decisions in infrastructure, particularly research data infrastructure, the needs and maturity of the research community in question should be considered early in the process. In the coming decade, New Zealand is likely to have one shot at developing digital infrastructure at a national scale in our research sector. We need to begin that development process with cross-sector research communities, as well as with individual institutions, if we aim to design the best outcomes.

ALIGN INCENTIVES

Connect planning and research governance

Our research institutions plan strategic activity over 5 to 15 years; however research strategy is set against 2 or 3 year funding horizons. The outcome is research projects that are designed with limited goals to avoid needing major infrastructure resources, and budgets include purchase of small scale capital items that do not lend themselves to shared use — or long term management.

Within institutions, governance and planning of contestable funds is poorly aligned with the governance and planning of institutional funds: policies and practices for ICT are applied to research methods with potentially ruinous consequences, distorting research design, subverting resources, blocking collaboration, and leading to sub-optimal application of the balance of government investment in science overall.

“Funding is a problem because there are sources of funding for sensors and experts, but less funding for building the data models that bring them together. We have a plan, but we haven’t been able to execute it to date - while we can see how to better organise the data, we’d have to stop research activity to spend the time doing the organising - and then we’d just have better organised data, not necessarily better science because we’d cut back on research for a time period.”

This misalignment between research governance and institutional planning arguably limits funding for major capital items, as well as limiting the resources our researchers can access and share. At a sector level, our system is highly fragmented — in many cases, our institutions appear to struggle with delineating collaborative and competitive activities. Collabora-

tion occurs more easily in the realm of contestable funding than in institutional funding, therefore government initiatives that fund collaborative research based around research disciplines appear more likely to produce impact than those focused on institutional collaboration.

“Our current approach (to investment) means our research communities are excluded from applying the most recent advances in research methods aided by the latest digital and information technologies, therefore excluding a growing and highly innovative raft of methods and approaches to research.”

FUTURE INFRASTRUCTURE

Visualise data for innovation and discovery

Major innovation or discovery in the coming decade is likely to stem from teams of researchers working across disciplines, institutions, and national borders, based on data from a proliferation of sources and with significant reliance on compute, integrated systems, sensor networks, and complex data analytics. Provision should be made early for investment in capacity and capability in data, visualisation, and digital research expertise, so that the New Zealand science system

“It’s vital we understand the eResearch isn’t something separate; rather it’s how all research (including primary sector research) will be done in the future — so eResearch needs to be built into all our plans, our projects and our institutions into the future.”

might continue to contribute to economic productivity and competitiveness.

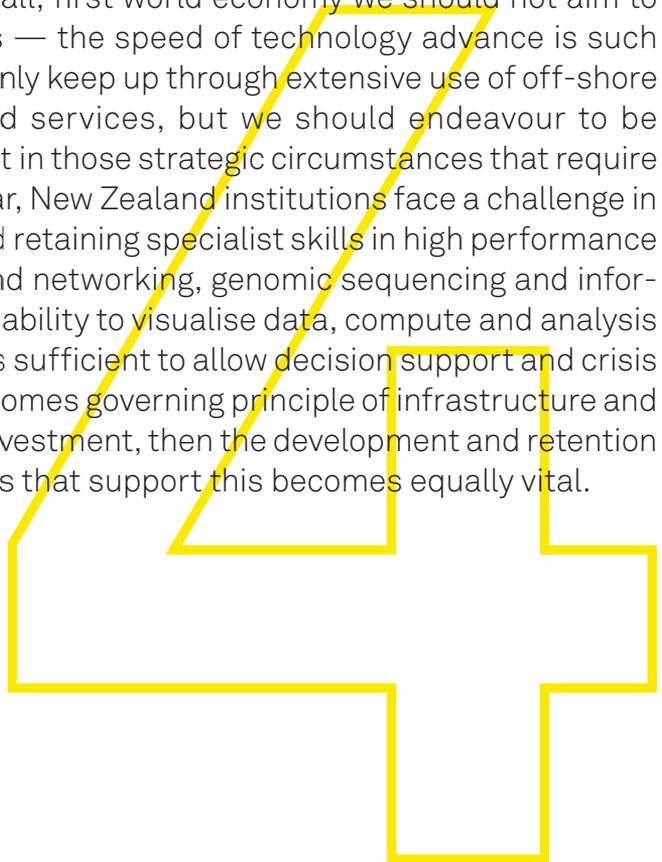
Visualisation of data — the ability to bring the power of vision to computational modelling, data analysis and collaboration — is a future critical capability across all research fields. In the very near future, our ability to interact with and visualise data will determine our capacity to innovate, to make serendipitous discovery, to manage our economy and institutions, and to respond to crises.

In the long term, we expect massive growth in data generation and transmission and in such an environment our

researchers move beyond constructing theoretical models of systems and can begin to analyse and optimise systems in real time. This capability, to understand a system in near real time, will present an innovation in research methods that may offer considerable advantage to those researchers who can access it.

“There’s an assumption of benevolence on behalf of large corporations that is not necessarily justified, so a practice of not putting too many eggs in one basket could be worthwhile.”

As a small, first world economy we should not aim to be isolationist — the speed of technology advance is such that we can only keep up through extensive use of off-shore providers and services, but we should endeavour to be self-sufficient in those strategic circumstances that require it. In particular, New Zealand institutions face a challenge in recruiting and retaining specialist skills in high performance computing and networking, genomic sequencing and informatics. If the ability to visualise data, compute and analysis in timeframes sufficient to allow decision support and crisis response becomes governing principle of infrastructure and technology investment, then the development and retention of talent pools that support this becomes equally vital.



Where should we be aiming?

The government’s draft National Statement of Science Investment is clear about the links between science investment and the economic and social development of New Zealand.

Our research sector needs to function as a best-in-class small country “research system”, leveraging larger resources off-shore, but maintaining key skills and core capabilities in New Zealand.

Major new capabilities we should aspire to enable might include some of the following:

_____ **THE ABILITY TO UNDERSTAND** and optimise a system — a water catchment, or a traffic jam – in real time, as data streams in.

_____ **THE ABILITY TO COLLABORATIVELY** respond in real time to an emerging situation — such as an earthquake — across multiple research institutions and government departments.

_____ **THE ABILITY TO VISUALISE** complex data and models to allow interactions that enable innovation and discovery.

_____ **THE ABILITY TO TRUST** and use data private, public, and proprietary data across social networks, public services, and research institutions.

“Digital research infrastructure allows researchers in NZ to compete internationally at scale, to work on larger projects, and to make impactful insights without the complexities of set up, operation or overheads of major equipment.”

A few expectations for research in 2020

Research Quality

By 2020, evidence and methodology in research will be completely digital. Open access to publications and data will put researchers' methods on display and play an increasing role in research impact assessment, leading to enhanced researcher skills and infrastructure services.

Digital Research Communities

By 2020, research, compute and data infrastructure will be designed and deployed for particular research communities, rather than for individual research institutions. Data communities will have a wide variety of maturity — some communities will need significant development while other research communities will demand advanced analytics and data management infrastructure. Very advanced research communities may move beyond national infrastructure and become self-supporting in a global context.

Integrated Research Sector Planning

By 2020, sustained engagement and linkages will be in place between the governance of research activity and the governance of research institutions. Integrated planning for research strategy, institutional development and national infrastructure strategy will operate against aligned funding horizons.

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National Capability

Beyond 2020, the ability to innovate and make serendipitous discovery will depend on data, compute and networking that is tightly coupled with visualisation. More and more, data and compute that is tightly coupled to and interacted with through data visualisation will play a role in how we understand real-time systems such as urban systems, pastures and farming systems, demographic systems and other myriad macro and micro socio-economic system-level drivers.

Summary

The aspiration is for the New Zealand research system to be functioning as a best-in-class small country sector in 2020.

“Inevitably, our society’s problems in the future are going to have a data and computation aspect to them.”

In the coming decade, New Zealand is likely to have one shot at developing digital infrastructure at a national scale in our research sector. We need to begin that development process with cross-sector research communities, as well as with individual institutions, if we aim to design the best outcomes.

Recommendations:

- 1___ Provide training and adjust incentives to address the growing skills gap in our research system.
- 2___ Better align governance, planning and funding cycles for institutional and contestable funding in research.
- 3___ Emphasise strategies that leverage off-shore services and infrastructure to preserve the on-shore human capability required to be self-sufficient.
- 4___ “Visualisation” will be the key enabling technology in innovation and discovery in the coming decade.

eResearch 2020

If we consider our socio-economic well-being to be linked in part to our research sector and our ability to understand the world around us, then arguably a lag in eResearch adoption may create limits to our productivity, our social cohesiveness, or to our capacity to monitor our environment, our borders, or our economy.

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