

Te Ara Paerangi – Future Pathways: REANNZ Response

1. Introduction

- 1.1. REANNZ appreciates the opportunity to respond to the *Te Ara Paerangi Future Pathways Green Paper*. REANNZ has a unique role and voice across the research and education system as we have an all of sector and global view. This gives us the ability to understand what is working and what is not from an access and collaboration perspective across research and education globally.
- 1.2. REANNZ is a National Research and Education Network (NREN). An NREN connects researchers to research, other researchers, and science infrastructure across the world. They do this by being:
 - **Global connectors** - there are over 120 NRENs globally, that work together to connect the global research community through the provision of high-speed networking, access and identity services so researchers can connect and collaborate wherever they are.
 - **Technical experts** - NRENs provide advice and services to enable researchers to maximise their use of global research networks and access key science infrastructure.
 - **Specialist network operators** - that provide seamless, real-time transfer of critical research data on a global scale.
- 1.3. To achieve this, NRENs operate differently, they inherently focus on collaboration reflecting the fundamental precept of research. This allows New Zealand researchers to connect to the world and ensures that distance is not a barrier to making a global impact.
- 1.4. REANNZ is a not-for-profit Crown-owned company under Schedule 4A of the Public Finance Act 1989. Our Shareholding Ministers are the Minister of Finance and the Associate Minister of Research, Science and Innovation. REANNZ is funded through MBIE's Strategic Science Investment Fund (SSIF) and our member organisations. REANNZ operates a closed membership model with members including Universities, Crown Research Institutes, Institutes of Technology, Polytechnics and independent research organisations.
- 1.5. REANNZ's mission is *Connecting researchers and educators so that they can change the world*. We do this by supporting a globally connected and resilient research and education sector through the management of a specialist network, tools and services that enable data intensive research collaboration, here in New Zealand and globally.
- 1.6. Our vision is simple to articulate but complex to achieve due to real and perceived barriers. It is expressed well in the green paper as a key feature of a modern research system: *"A high degree of connectivity, with collaborative projects the norm, and researchers who are able to move easily between institutions, and into and out of industry and public services. A high priority is given to participation in global research communities, even when addressing mainly local problems or opportunities."*

2. Executive Summary

- 2.1. Research system access, supported by strong governance is key to enabling the level of collaboration envisaged in the green paper. Equitable system access means all parties having the required level of access to systems, databases, and research infrastructure no matter who they work for or where they are based.
- 2.2. To deliver equitable access across the research system the following needs to be considered:
- **Access for all** - the capabilities of the research system should be available to all organisations engaging in research on a merit or strategic basis. This means public and private sector organisations, no matter how large or small.
 - **Governance** - establishing an independent research council to govern the research system. The remit should include stipulating who has access, what infrastructure is managed centrally, interoperability of the system, research priorities and talent development.
 - **Researchers everywhere** - cost must not be a barrier to access. Public and private sector users of key national science infrastructure should pay to use the infrastructure. However, the users should pay a price based on the nearest equivalent commercial service, with the difference being met centrally.
 - **Providing access** - is not just about connectivity; it is about interoperability. We need to ensure consistency of approach across the research system in areas such as cyber security, identity management and network architecture.
 - **Future talent** - the system needs to look for opportunities to lean in more to the education system to purposefully build the talent pipeline beginning at primary school.
- 2.3. The following sections contain our response in more detail. We have responded to the following themes raised by the Green Paper including funding, the research workforce and national research infrastructure.

3. The research system should be open to public and private sector researchers

- 3.1. The world today is facing “wicked problems”¹ that need the best global minds to collaborate in virtual teams to find solutions.
- 3.2. A recent example of a wicked problem has been Covid-19. In a 2021 Lancet article the authors acknowledged a key factor in the success of the global response was that “*the international research community - including academic, health, industry, and professional groups - [they] collaborated from the outset, through early exchange of laboratory and surveillance data, genome sequences, and information on clinical outcomes*”².
- 3.3. The article produced a scorecard of the global Covid-19 pandemic response and found the key areas of success in the research, collaboration and information sharing space were:

¹ Mission-oriented innovation policies: challenges and opportunities, Mariana Mazucatto (<https://academic.oup.com/icc/article/27/5/803/5127692?login=false>)

² [https://www.thelancet.com/journals/lanpe/article/PIIS2666-7762\(21\)00198-8/fulltext](https://www.thelancet.com/journals/lanpe/article/PIIS2666-7762(21)00198-8/fulltext)

- Sharing of information by researchers
- International research collaborations
- Public data repositories

Due to the nature of the pandemic normal institutional and public/private sector barriers were removed to facilitate collaboration.

- 3.4. The shortcomings highlighted in the report resulted from the lack of centralised governance:
- Lack of systemic global research governance
 - Duplication of research studies
 - Most funding from national efforts
- 3.5. Locally Fisher & Paykel Healthcare is an innovation success story. In a 2019 interview³ VP Corporate Marcus Driller responded to a question on the advantages to being based in New Zealand with *“A small local market like NZ encourages tight links between industry, universities, and hospitals. It also ensures a need to think globally and has instilled in us a need to do things differently to successfully compete.”*
- 3.6. The above examples illustrate how successful outcomes have been obtained by researchers working with whomever they need, regardless of whether they work in the public or private sector. Such collaborations have been shown to deliver positive social⁴ and financial⁵ outcomes.
- 3.7. Research system access, supported by strong governance and agreed protocols around data management, Māori data sovereignty and security are key to enabling this level of collaboration. System access means all parties having the required level of access to systems, databases, and research infrastructure no matter where they are. Today institutional, funding and remit barriers are limiting the ability of private sector companies (large and small) to access the system.
- 3.8. Many private sector organisations have well-funded research and innovation departments. Fisher & Paykel is mentioned above, and others below. The question is: what would happen if we embedded the research divisions of these entities into the research system and gave them access to national research infrastructure? If additional costs of access are covered by the private sector, what does New Zealand have to lose?
- 3.9. The below examples show how the research departments of large commercial entities collaborate with the national and global research sector on a regular basis:
- **Rocket Lab** - partners with universities and researchers around the world. Most recently they announced a partnership⁶ with John Hopkins University (JHU) Applied Physics Laboratory (APL).
 - **Volpara Health**⁷ - based in Wellington, a global health provider using digital imaging technology to save families from cancer, by preventing advanced stage breast cancer.

³ <https://tin100.com/billion-dollar-businesses-fp-healthcare/>

⁴ <https://www.nzdoctor.co.nz/article/mortality-declines-aotearoa-nz-during-first-two-years-covid-19-pandemic>

⁵ <https://www.rnz.co.nz/news/business/443476/fisher-and-paykel-healthcare-posts-record-full-year-result>

⁶ <https://www.rocketlabusa.com/updates/rocket-lab-signs-exclusive-license-agreement-to-manufacture-space-radio-technology-from-johns-hopkins-university-applied-physics-laboratory/>

⁷ <https://www.volparahealth.com/>

They regularly collaborate with university researchers from the US, UK, Europe, and Saudi Arabia among others.

- **Fonterra**⁸ - originally a spin off from Massey University, Fonterra Research Development Centre in Palmerston North is home to over 130 PhDs and 350 dairy patents. The Centre is complemented with innovation centres in Melbourne, Amsterdam, Chicago, Shanghai, and Singapore.
- **Wakatu**⁹ - a corporation with the purpose to preserve and enhance our taonga for the benefit of current and future generations. In fulfilling this they are conducting research programmes locally and are collaborating with climate research centres in Denmark, and research institutes in Japan and Switzerland.

3.10. The research partners mentioned above are used to collaborating globally using the tools and networks of the global NREN community. By opening this capability to the private sector we can facilitate collaboration with New Zealand using NREN tools and networks they are familiar with.

3.11. Technically this can be done, the discussion is around policy settings. Two decisions need to be made:

- **Private sector researchers/innovators** - decide to make global NREN capability accessible to the private research sector.
- **Funding** - agree on the approach. The proposal is that the private sector pays for access at a rate equivalent to market rates. This reduces a barrier to public-private sector collaboration, brings in private sector funding and doesn't undermine competition across the private sector.

4. System wide standards need to be set by an independent governance body

4.1. For the system to work REANNZ considers strong central governance is important. REANNZ supports the argument that governance needs to be collectively enabled by an Independent New Zealand Research Council as suggested by Universities New Zealand.

4.2. Governance should not be buried in individual institutions but rather be collectively enabled by an Independent New Zealand Research Council as suggested by Universities New Zealand – Te Pōkai Tara response to the Green Paper *“an independent research council could have oversight of the research system, including infrastructure, capability development and emerging frontiers of knowledge, and be responsible for setting research priorities”*¹⁰.

4.3. This research council should have representation from Māori and Pacific communities as well as the private research sector.

4.4. To be effective it is likely that the governing body should be responsible for:

⁸ <https://www.nzmp.com/global/en/about-nzmp/innovation-and-ingenuity/the-fonterra-research-and-development-centre.html>

⁹ <https://www.wakatu.org/>

¹⁰ <https://www.universitiesnz.ac.nz/sites/default/files/uni-nz/documents/UNZ%20submission%20on%20Te%20Ara%20Paerangi%20-%20Future%20Pathways%20Green%20Paper.pdf>

- **Setting national research priorities** - REANNZ is supportive of the ambition in the Green Paper to establish a consistent and enduring set of national research priorities for New Zealand.
- **National research system access** - define who has access to the publicly funded resources of the system and set the cost for access. As above, REANNZ recommends the definition be extended to include all public and private sector researchers and research institutes under an agreed access protocol.
- **Global research system access** - ensure the system meets international standards to ensure global interoperability (security, network, privacy). An example of this is the Global NREN standards REANNZ must meet to participate in the global community.
- **Researchers everywhere** - ensuring the system is accessible wherever researchers are.
- **Access to technology** - set the access and security standards to be met before system access is granted. This is becoming more important due to the changing security landscape and the increasing value of data.
- **Data stewardship** - promote standardisation of data management practices to facilitate interoperability across the system. This includes working with tangata whenua to develop a national Māori Data Sovereignty framework.
- **Future Talent** - actively support outreach and flax roots initiatives that are focused on engaging children in the science sector from primary school.

5. Institution type and size should not be a barrier to research system access

5.1. Today barriers to system access exist in two areas:

- **Financial constraints** - the constraints of existing membership models.
- **Access to infrastructure** - outside of home institutions.

5.2. Considering financial constraints first, researchers and smaller entities may not be able to afford to access key research system infrastructure. Research system infrastructure can be expensive due to its specialisation and may be too costly for individual research organisations to buy and operate themselves.

5.3. Due to its specialised nature the Government funds some infrastructure in full, or in part via SSIF. The infrastructure funded today ranges from the Tangaroa Research Vessel, the Australian Synchrotron through to the REANNZ network¹¹.

5.4. The REANNZ network is partially funded because NRENs are highly tuned networks designed to hold capacity to transport large volumes of data over long distances with low packet loss and predictable latency. This type of network is more expensive to run than a commercial network, as holding capacity comes at a cost premium.

5.5. REANNZ members cover the unfunded portion of the network through membership fees. All members, regardless of their size or research area pay to access the network and associated NREN services. This leads to inequity because smaller research organisations

¹¹ <https://www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/strategic-science-investment-fund/>

cannot afford the membership fees, therefore they cannot access the network or the NREN services.

- 5.6. The inequity arises because access to the network also gives access to the global NREN services. For example: eduGAIN is a service that underpins global science collaboration and is accessed by c27,000,000 researchers, students, and educators annually. We have potential members who want access services such as eduGAIN¹² to access global data repositories, libraries and infrastructure but can't afford to because of the high membership fees driven by the cost of operating the network.
- 5.7. This can be addressed by REANNZ's position that members should pay a commercial equivalent rate to access the network, with the difference being met from public funds. This allows for a sliding scale fee model so smaller entities would no longer be prevented from accessing and collaborating with the wider system due to cost constraints.
- 5.8. The second issue to be overcome is where access is restricted to researchers' home institutions. Access to system infrastructure can be limited by who you work for, and where you work. Today researchers based in large institutions have access to science infrastructure that isn't always available to those in the regions, or in smaller institutions. This further encourages inequality in the system and is a poor outcome for a national research eco-system. As more infrastructure is digitally enabled and connectivity improves, remote system access becomes easier allowing science infrastructure to support research wherever it is being undertaken.
- 5.9. Research in the regions is thriving as can be seen in research programmes run by entities such as Wakatu (Nelson) and Te Hiku Media¹³ (Northland) and individual researchers running field trials in remote locations¹⁴.
- 5.10. The technology exists today to enable this today, if we find a way to remove funding barriers and agree to making system access available to all researchers, we can do this. The technical considerations are discussed in the next section.

6. The research system must be available to researchers everywhere

- 6.1. To deliver equitable outcomes the system must provide universal access to technology, information, and education. The challenge is how to ensure ubiquitous access?
- 6.2. There are five technical components to answering this question:
 - **Connectivity** - needs to be ubiquitous.
 - **Interoperability** - a consistent way to access the capability of the research system.
 - **Data stewardship** - create rules and frameworks around data management to facilitate data sharing and collaboration.
 - **Trust** - of the technology, and the underpinning infrastructure such as networks.

¹² <https://edugain.org/>

¹³ <https://tehiku.nz/te-hiku-tech/papa-reo/11261/te-hiku-media-awarded-13m>

¹⁴ <https://www.scionresearch.com/about-us/about-scion/corporate-publications/annual-reports/2021-annual-report/delivering/monitoring-planting-success-using-ai-and-remote-sensing>

- **Private sector expertise** - leverage the best of the private sector expertise (for example in security and cloud) to support the public sector. Make the expertise widely available so decision makers and researchers know what technology is available, how to use it and how it all networks together.

6.3. **Connectivity** - the first step to providing access is ensuring researchers can connect to the system, wherever they are. Be that in a large city, regional hub or the field. The technology to deliver this exists today:

- **National backbone** - connecting research institutions and science infrastructure. The REANNZ network provides this in our role as New Zealand's NREN¹⁵.
- **Global connectivity** - facilitates global collaboration. Through the international federation of NRENs REANNZ provides this today in over 120 countries¹⁶.
- **Seamless connectivity everywhere** - outside of the main centres' connectivity is provided by multiple operators offering services ranging from fibre and WIFI to 4G and satellite options.

The opportunity exists for a central entity such as REANNZ to broker and manage a nationwide connectivity solution that extends beyond the physical borders of our network today. As shown above the tools exist, what is missing is the commercial construct and management layer - both of which REANNZ is well placed to deliver.

6.4. **Interoperability** - once researchers connect to the system, they need to do so consistently. Consistency will become more important as researchers form virtual organisations to focus on key priorities and then return to their home institution once their work is complete. Flexibility is not inherent across the research system today, but solutions do exist:

- Federated identity management - gives users from one institution trusted access to services and resources provided by another institution. REANNZ offers this service, Tuakiri, within New Zealand and globally via Tuakiri's participation in eduGAIN – the world wide 'federation of federations'. Tuakiri adapts an institution's identity management¹⁷ platform to a consistent and internationally recognised format. Today 3,500 global identity providers participate in eduGAIN, each institution's identity investment is maximised by making services of the global federation available to its staff, students and researchers.
- Interoperability centre of excellence - there needs to be a centralised team comprising network architect and developer skillsets. This team will support architecture design decisions that enhance the reach and the performance of key science infrastructure by ensuring interoperability. REANNZ performs this role for its members and offers solutions to help bridge interoperability gaps, hosted IdP for example.
- Data stewardship - researchers need the support of data stewards to provide advice on documenting, organising and preserving their data. They are the "humanware"¹⁸ that

¹⁵ <https://www.reannz.co.nz/the-network/guiding-principles-of-the-reannz-network/>

¹⁶ <https://www.reannz.co.nz/the-network/reannz-network/>

¹⁷ Identity and access management - the discipline that enables the right individuals to access the right resources at the right times for the right reasons. Usually run by an institutions IT team.

¹⁸ <https://www.inthefieldstories.net/data-stewards-to-the-rescue-please/>

connect vast data sets with researchers, and drive for standardisation to ensure interoperability. In addition frameworks covering areas such as Māori Data Sovereignty and data labelling need to be developed to support researchers.

- Capability building - the centre of excellence should also focus on upskilling IT teams and researchers on how to use these new technologies and approaches. Currently capability building is limited to individual institutions or in the case of REANNZ and NeSI to members only. This fragmented approach further embeds inequity in the system.
- Trust - a key element of interoperability. Users of the system must trust the system will be available when they need it and that it will protect their data. Trust is difficult when different entities apply different standards. There is work being undertaken across CRI's¹⁹ to standardise their approach to cyber security across the sector. While different CRIs have different levels of risk appetite using a consistent framework enables them to talk the same language and to build up an understanding of sector wide risks. It is REANNZ's perspective that the governance body should consider this model and set common standards across the system. As above REANNZ is well placed to broker these arrangements on behalf of the system.

REANNZ was established as the organisation to facilitate international and national research collaborations. Interoperability is key to successful collaborations and is a goal of the global NREN community. The above examples illustrate additional ways REANNZ can further support interoperability across the sector.

This focus is aligned with the REANNZ constitution which states the purpose of the organisation is to provide the network, international connections and “enable new forms or research and new research collaborations.”

REANNZ would welcome the opportunity to lead or participate in a broader system-wide discussion around the benefits of a consistent sector wide approach to identity, access, data stewardship and security.

6.5. **Private sector expertise** - there is an acknowledged national and global IT skills shortage²⁰ impacting both private and public sectors. There needs to be a careful review of areas where centralising key services could reduce duplication and drive efficiencies. Three examples where expertise may be better placed in the private sector are:

- Cloud Management - a private sector cloud provider could provide core services to the research sector. This would allow the research sector to benefit from the private sector investment in cloud infrastructure. Centralising cloud services could also provide a level of consistency around approaches to data management and data sovereignty.
- Cloud Storage - broker sector wide cloud storage agreement(s) (alongside DIA) to enable the sector to leverage its scale and scope in commercial negotiations, but also to facilitate a common approach to data storage and retrieval.

¹⁹ Led by CIOs from AgResearch and ESR.

²⁰ <https://nztech.org.nz/2021/07/05/new-zealand-facing-a-digital-skills-crisis/>

- Security Operations Centre - across the research sector there is an increased awareness on the importance of cyber security. As highlighted by the GSCB²¹ research institutions have been targeted during the COVID-19 pandemic, the same briefing highlights that malicious actors are putting effort into researching sensitivity of data as that strengthens their ability pressure organisations to pay ransom demands. A tool in strengthening the security posture of these organisations is 24/7 risk monitoring of networks. There is the opportunity for a central organisation such as REANNZ to broker similar services centrally to both drive consistency and leverage the collective buying power of the research sector.

7. The system needs to grow future talent

- 7.1. Key to an effective research system is an education system that delivers talent into the system. It is at school that passion for science is first nurtured, it is also at school that the first impacts of inequality that can hinder future participation in the sector.
- 7.2. Digital capability is a key component of research, and New Zealand needs students who operate in a digital first mindset to be entering the system. REANNZ is working with the Ministry of Education to support their Equitable Digital Access initiative. This will see our collaborative services eduroam (federated WIFI authentication) and Tuakiri (federated identity management) solution rolled out across digital hubs and homework centres. This will mean children who are unable to study at home for any reason, have a safe location where they can get online (eduroam) and access school systems (Tuakiri). REANNZ's response²² to the "*Towards a Digital Strategy for Aotearoa*" outlines this in more detail, including where this has successfully been implemented overseas.
- 7.3. The next step is to explore ways to work further with the education system to support school level research initiatives either directly, or as components of existing flax root research programmes.

8. Conclusion

- 8.1. REANNZ is looking forward to continuing the discussions raised in this paper and maximise our contribution to enabling a sector that is connected, adaptable and resilient.
- 8.2. As outlined in our submission there are areas of consideration that REANNZ considers are important to the vision outlined in the green paper. These are as follows:
 - Make the capability of the research system available to private sector researchers.

²¹ <https://www.gcsb.govt.nz/news/the-changing-landscape-of-cyber-threats-and-organisational-responses/>

²² <https://www.reannz.co.nz/news-and-events/towards-a-digital-strategy-for-aotearoa-reannz-response/>

- Establish an independent research council to oversee the interoperability of the research system.
- Make the research system accessible to all researchers by removing financial and technical barriers to entry.
- Ensure interoperability across the system by setting standards to enable technical access, and frameworks to address areas of Māori data sovereignty and data management.
- Leverage private sector expertise to support the research system adopt new cloud technologies and respond to new cyber threats.

8.3. The above focus areas are aligned with the REANNZ constitution which states the purpose of the organisation is to provide the network, international connections and “enable new forms or research and new research collaborations”.

8.4. REANNZ looks forward to working with the sector to further develop the thinking in our submission over the coming months.

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