

Building an ethical, agile, collaborative research system

Te Pūnaha Matatini submission to Te Ara Paerangi

Whanake ake! Whanake ake!

Key message

We thank MBIE for the opportunity to participate in this major policy reform.

These reforms need to be bold.

Te Ara Paerangi presents an opportunity to transform Aotearoa New Zealand's Research, Science and Innovation (RSI) landscape into a more connected, resilient and adaptive complex system that:

- Privileges tikanga
- Centres people and relationships
- Realises intersectional diversity through access, equity and inclusion
- Enables inter- and transdisciplinary research

Who we are

We represent Te Pūnaha Matatini, a Centre of Research Excellence (CoRE) in complex systems composed of researchers from tertiary institutions, government institutes, private sector organisations, and marae communities from throughout Aotearoa New Zealand, who jointly submit this response.

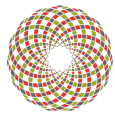
We are the sole CoRE dedicated to complex systems research. As researchers who apply inter- and transdisciplinary approaches to address the most complex and critical issues of our time (pandemics, climate change, intergenerational equity), we are well-placed to comment on the challenges and opportunities facing Aotearoa New Zealand's RSI system.

We are scholars from a range of academic disciplines, graduate and undergraduate students, Māori community leaders, and on-the-ground practitioners. Around 70% of our graduates currently find employment in Aotearoa New Zealand. Our collective research practice responds to the urgent need for innovative inter- and transdisciplinary approaches.

Our strategy is to transform the research system by embedding a strong foundation of values that permeates the work that we do on complex systems. We explicitly focus on training ethical, collaborative researchers who are excellent with complex data across diverse sectors. This focus includes a Kindness in Science grounded project to understand

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the actors, drivers, practices, and policies that embed ethical and inclusive approaches in Aotearoa NZ's research system.

Te kawau mārō

Kia mau tau ki tēnā

Kia mau ki te kawau mārō

Whanake ake! Whanake ake!

Stick to that, the straight-flying cormorant!

- Maniapoto

What are complex systems? When birds flock for flight, they move from an individual state to a highly ordered structure that enables them to move together, aiding their collective journey. The kawau, or shag, extends its neck as it prepares to dive. Maniapoto's military strategy—te kawau mārō—is based on coordinated collective action that punches through existing barriers to create beneficial new outcomes.

In reducing the world to its constituent parts, the traditional frameworks of our universities and national research institutes fail to describe how people, the economy, and the environment can, do and must relate to each other.

Complexity science enables new ways of seeing and understanding the world. Its key features—connections, feedback, attractors, intervention points, critical transitions, and emergence—all offer new, innovative ways of tackling societal problems. The flight of the cormorant reveals how seeing and understanding the structures behind phenomena can bring unexpected insights (Figure 1).

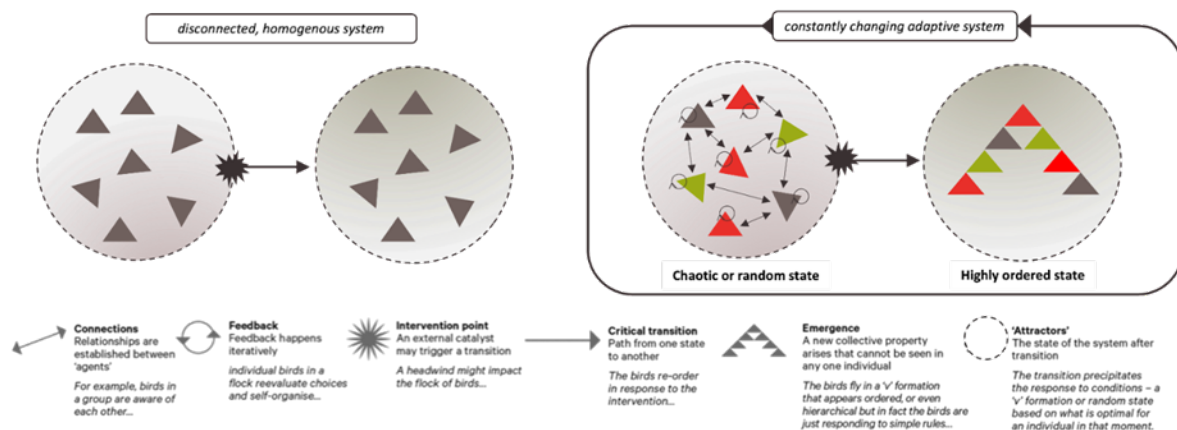
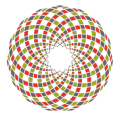


Figure 1. Te kawau mārō. The flying kawau (cormorant) ordering as a group in flight into an arrow formation is an example of a complex system.



Our recommendations

Reform of the RSI landscape should focus on the areas with the strongest potential for, and gains from, transformation.

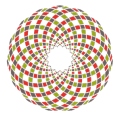
Based on the preliminary data that we currently have, and noting the data gaps that exist, Te Pūnaha Matatini supports the following actions:

Tikanga and best practice

- Grounding the behaviour of institutions and research teams in tikanga, and the lived values of mana, manaakitanga, aroha, pono, and whanaungatanga. This will enable permeability of researchers across and between disciplines, and groups, in ways that are safe.
- The continuance of te ao Māori conceptual frameworks and practices within research spaces, including acknowledgement of, for example, consensus decision-making, inclusion of whāngai, manaakitanga in its many forms, and kaumātua as guides. Researchers being enabled and encouraged to learn and connect with the cultural epistemologies that are right for the researcher and/or the research work being undertaken, acknowledging that ‘non-matched’ cultural combinations may grow innovative research.
- Engaging with and hearing local communities, including whānau and hapū, in shaping the research landscape. These communities must be recognised as actively engaged in and contributing to research rather than treated as the passive recipients of these policy reforms:
 - Recognising communities, marae, whānau, and hapū as knowledge-making and knowledge-using communities with knowledge needs and aspirations in their own right.
 - Including communities, marae, whānau, and hapū as partners in determining research needs and aspirations, and appropriate ethical research practice.
 - Enabling communities, marae, whānau, and hapū to design and undertake research (with or without research partners of their choosing).
- Increased investment in growing future researchers, particularly from kura.
- Growing and supporting narratives of people from diverse backgrounds belonging in the research community.

Research priorities

- Establish a professional board for all researchers that upholds tikanga and ethical behaviour in research spaces (see for example, the NZ Medical Council or Psychologists Board), and to which all researchers are required to belong in order to practice, to create a safe and thriving research system.
- Develop robust, transparent and just practices to address bullying and harassment across the system.
- Collect and analyse relevant, consistent and longitudinal data on the communities of people that enter, leave, and remain in, our national RSI system, and how this has changed over time.
- Develop sufficient ongoing science policy capacity to consider the trust society places in research, in order to address major issues and potential crises of the 21st century, with the ability to generate insights from sources ranging from system data to ethics.



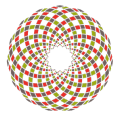
- Support increased internship and postdoctoral programmes that place early career researchers into roles within central government (see Truax 2022), or with community organisations, iwi, industry or regional councils.
- A change from short-term (e.g. three-year) funding cycles to longer time frames (e.g. five-year). In other words, a shift to “slow science” that has realistic workloads, does not lead to burnout, and has a reduced administrative load.
- Support for inter- and transdisciplinary research. Trans-disciplinary and complexity research are essential to address the critical challenges of the next 10-15 years in particular, from a low carbon future to biodiversity loss and climate change. We caution that favouring silos of pure or applied research, or particular disciplines, is not useful here, although deep knowledge of disciplines is required for excellent inter-disciplinary work.
- Increased connectivity across the system, for example by partnering with communities, and by re-integrating the Crown Research Institutes (CRIs).

Funding

- PhD tax-free stipends equivalent to the living wage (on an ongoing basis) as a minimum, with the possibility of extension up to four years (full-time FTE), from all granting institutions, to ensure students are paid to completion.
- Kaumātua and mentor-leaders embedded as necessary professionals in the research system, as pou, kaiarahi and tuakana for all students, as a practice of tikanga.
- The return of a university postdoctoral scheme that provides the opportunity for further research training for Aotearoa New Zealand citizens in the first five years post-PhD. Research that partners with Aotearoa New Zealand communities is frequently best continued within an Aotearoa New Zealand context. A domestic postdoctoral scheme would support the retention of diverse graduates with strong linkages to both policy and society.
- Removal of university- and institution-applied overheads from postdoctoral fellow salaries on grants, to re-balance investment in early career researchers.
- Base funding tied to people, not institutions, to allow for agile and rapid responses to rising critical issues. For example, such funding could help the mobilisation of researchers, to prepare for crises from pandemic responses to misinformation.
- Paid parental leave policies to include PhD students and postdoctoral fellows on multiple contracts to encourage retention of women in science.

Workforce

- Funded pathways for students and researchers to link or transition into business research and development as well as anticipatory policy.
- Careful consideration of what might be an optimal balance between Aotearoa New Zealand and international researchers, with a scheme to preferentially employ Aotearoa New Zealand citizens and permanent residents.
- Increased transdisciplinary opportunities for researchers, including increased CoRE funding.
- Transparent and open data analytics that tell us more about the New Zealand RSI workforce, so that policy and support is evidence-based.
- A commitment to appropriate workload for researchers.
- Increased employment of useful administrative support to enable research, and less focus on management, metrics and bureaucracy.



Background and evidence

Elinor Ostrom's work identified both the need to solve dilemmas by rebuilding trust, and the connection between 'science and society'. We extend this to the rebuilding of trust 'within research'. Meadows' eight principles (Figure 2) can help redesign the purpose, governance and management of the RSI system, so that it is vibrant and collaborative internally and externally, by building a valued and trusted workforce.

For example, a values driven and people-focused base funding system (Baisden, 2022), which emphasises tikanga, aligns with Meadows' foundation of values-based 'intent', and her scaffolding of social 'design' to encourage and incentivise scalar redirection and coordination towards self-organisation. A self-organising system implies one with enhanced trust, and reduced constraining managerialism and bureaucracy. Nonetheless, consideration of scales of interactivity, from small to large, and the treatment of issues such as data sovereignty, and commercialisation, will be beneficial.

We use Meadows' (1999) system of prioritisation for complex systems (Figure 2) to focus on those areas with the strongest potential for, and gains from, transformation, and to identify pathways where trusted self-organising frameworks can guide a revised definition of 'success' for our RSI.

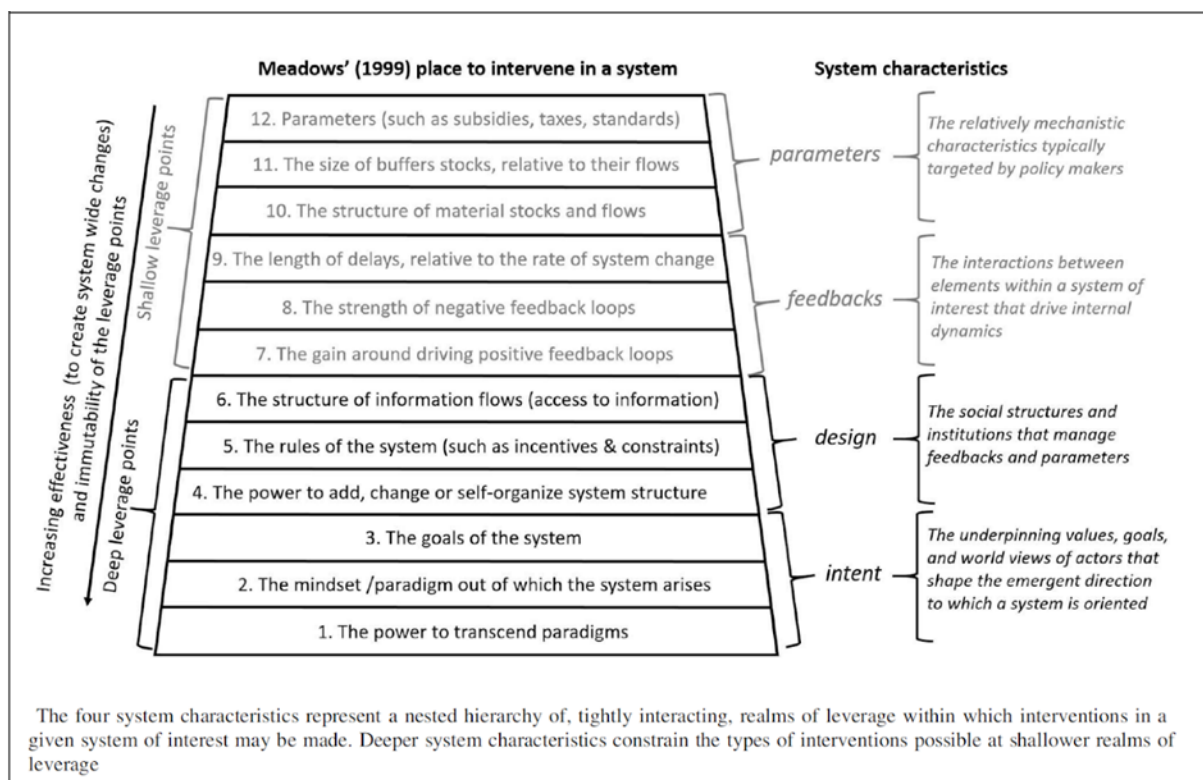
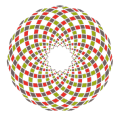


Figure 2. Donella Meadows' 1999 work on complex systems defines both system characteristics and identifies optimal places to intervene and create system-wide changes (figure from Abson et al., 2017).

A complex RSI system should be **relational**, **people-centred**, and **tika**.

Māori systems approaches are, by their nature, collective and relational. 'Whanake ake! Whanake ake!' refers to the way that individual birds in a flock develop and rise up collectively to affect and achieve common purpose. As with a flock of kawau, our RSI



system is made up of people (who in turn, make up the institutions) who have numerous interactions. These interactions include connections among individuals (e.g., tuakana-teina relationships, community relationships), institutions (e.g., between people in tertiary education organisations (TEOs) and CRLs) and sectors (e.g., between people working in research, industry, community and state).

Our connections enable a collective response to ‘intervention points’ as well as responsiveness to feedback (Figure 1). When relationships between people throughout the RSI system are strong, with common ethics, we are coordinated and poised to meet sudden and/or complex societal challenges.

A right and just RSI system prioritises **active commitment** to access, equity and inclusion. Diversity is intimately related to the functioning and robustness of complex systems (Page, 2010). The capacity for Aotearoa New Zealand’s RSI system to be cohesive and adaptive, like the kawau, rests upon intersectional diversity—not least, in worldview, identity, expertise, and lived experience (Forrester, 2020).

A people-centred and tika RSI system should **enhance collective and individual well-being**. For example, in flock formation, frequent switches between leading and trailing positions may share and reduce the overall energetic cost of flying (Voelkl et al., 2015). These principles speak to concepts such as tuakana-teina, where all have something to contribute (and ultimately gain).

The culture of research

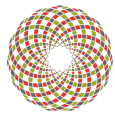
Tikanga is increasingly recognised as the first law in Aotearoa New Zealand, that is available to all the diverse identities in Aotearoa New Zealand to position themselves within.

We support tikanga and its overarching principles, moving away from derivations of status, individualism, hyper-competition and other processes that act as barriers, and are currently embedded in institutions. We support research partnerships with communities where decision-making rests with the collective partnership, and the autonomy of communities to choose who they partner with.

Te Pūnaha Matatini supports the growth and retention of talent in Aotearoa New Zealand, and career pathways into government and industry that will strengthen collaboration across the research and development workforce, including at the science-policy interface (Truax, 2022). We support permeability between policy, government, industry, community and the research workforce.

Bullying and harassment are regularly reported in the research system, but it is often unclear what measures are taken, what consequences are meted out, and what changes as a result. It is tika that these issues are taken seriously, and that researchers and students alike can feel safe. For this to happen, robust, transparent and just practices are required.

We anticipate that moving away from a hierarchical RSI system toward one that demonstrates reciprocity, mutual respect and an ethic of care (Osier & Murungi, 2021; Tronto, 2010) will reduce individual burnout and better enable marginalised groups to participate. In addition, introducing anonymous 360-degree feedback for all participants in a funding arrangement would encourage more transparency and accountability in funding environments. Valuing and measuring for desired wellbeing-centred outcomes and diverse



forms of knowledge, rather than existing market-based metrics, could augment this (Ratuva, 2021).

There have been calls to resist the growing demands of neoliberal academia and for institutions to instead support researchers to undertake sustained engagement with diverse research partners, e.g., through slow scholarship (Hartman & Darab, 2012; Mountz et al., 2015) that demonstrates genuine social impact (Ratuva, 2021). By building trust and self-autonomy in the system, we anticipate that individuals and scientific teams will be more agile and better placed to co-create research that is responsive to Aotearoa New Zealand's needs in a rapidly changing world.

We are encouraged by the commitment of Te Ara Paerangi to Te Tiriti o Waitangi, to realising Māori aspirations for research and to enabling mātauranga Māori. Yet, little attention has been given to other marginalised groups, and in particular, the interconnected nature of social categorisations such as race, class, abledness, sexual orientation, and gender (Crenshaw, 2015).

Women and marginalised groups who are discriminated against in terms of advancement (e.g., Walker et al., 2020) are also often those who might lead a collaborative and collegial and ethical approach to research (Borgerson, 2019). Genuine systemic transformation that aligns with Māori systems approaches will open the way for new types of scholarship, and address access, equity and inclusion for all intersectional communities marginalised by the current system.

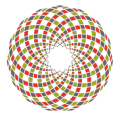
Our approach towards achieving transdisciplinarity is that it is not at the expense of discipline level rigour. We highlight the opportunities afforded in bringing together disciplines that might not otherwise be in conversation, but emphasise that transdisciplinarity is only possible where disciplines exist in the first place, and that antidisciplinarity risks homogenisation and dilution of what makes diverse disciplines unique, useful in their focus, and helpful for resilience towards solving complex problems (Care Operative, 2022).

The changing landscape of the RSI system

Drawing from current work by the Kindness in Science project at Te Pūnaha Matatini, we propose two connected, working hypotheses regarding the RSI system:

1. **Despite systemic barriers, the national RSI landscape *has* begun to slowly change** from one of hyper-individualism to one that is more collective, connected, and diverse, which shows promise for the future.
2. To move from *step-changes* to *transformative change*, **a commitment to shared values** in our RSI is imperative for accountability, and to provide a vision for a system we collectively buy into.

By aligning our values and finding common purpose, like the kawau, we establish an agreed orientation to fly in. However, flocking is a learned behaviour (Wakefield et al., 2019). Similarly, realising these core attributes of a resilient and adaptive complex system—of shared values, connectedness, and diversity—calls for deliberate and sustained system-wide action.



To provide preliminary evidence of a changing RSI landscape, and as background for a forthcoming reflexive analysis, we present an exploratory co-authorship network analysis based on publication data for Te Pūnaha Matatini-affiliated researchers (Figure 3).

In conjunction with initiatives introduced to increase diversity, equity and inclusivity in Te Pūnaha Matatini (e.g., Te Pūnaha Matatini Code of Conduct in 2016; establishment of the Deputy Director for Equity & Diversity role in 2019; calls for prospective investigators to address Te Tiriti, equity, diversity, access and inclusion), **Figure 3 highlights a shift in Te Pūnaha Matatini toward a more connected research landscape.**

There are more connections between different research teams in mid to later years (i.e., publications from 2017 onwards in green and red, Figure 3) compared to the first three years of Te Pūnaha Matatini (i.e., publications from 2014–2016 in brown-grey; Figure 3). We anticipate the inclusion of qualitative approaches, disciplinary and institutional affiliations in future work will further reveal the trajectory and needs of our changing RSI landscape.

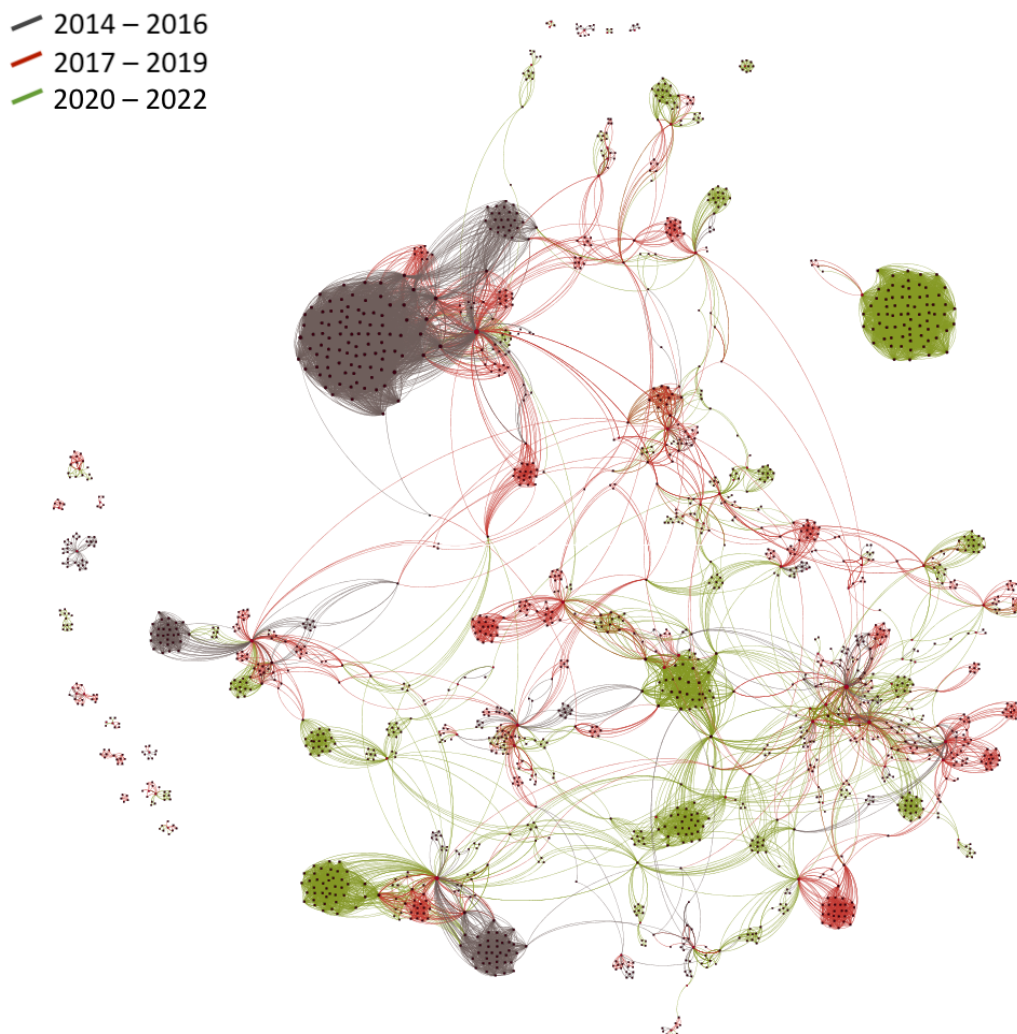
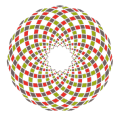


Figure 3. Undirected network showing 1,804 (co-)authors of 513 journal publications scraped from Scopus on 10 Mar 2022 using Te Pūnaha Matatini annual reports (2015–2020/21) and by searching for ‘Te Pūnaha Matatini’ or ‘Te Punaha Matatini’ in author affiliations. Edges (i.e., connections) in brown-grey represent co-authorship from publications in 2014–2016; red edges represent co-authorship during 2017–2019; and green edges represent co-authorship during 2020–2022. Network generated in Gephi (Bastian et al., 2009) with the ForceAtlas2 algorithm (Jacomy et al., 2014) using default settings except for: scaling set to 50.0; stronger gravity selected; gravity set to 0.05; and overlap prevented.



The current RSI system

The research system has been described as one that supports and promotes exclusion, individualism and oppression, while rewarding those who follow existing, entrenched norms, and penalising those who challenge them ([Bergland, 2021](#)). Hyper-competitive individualists (encouraged by ranking practices such as PBRF) have pervasively been selected for success in an outmoded system that ‘picks winners’ as part of a zero-sum, ‘finite game’ ([Harre et al., 2017](#)).

Work that highlights inequities in the education and research system includes Brower & James, 2020; Kidman, 2020; McAllister et al., 2021; McAllister et al., 2022; Naepi, 2019; Soar et al., 2021; Sommer, 2010; Walker et al., 2020; Wehi et al. 2014; Wehi et al., 2019. We reviewed how the present system developed, and, using the approaches of Meadows and others, what this suggests for fixing it from a systems perspective ([Baisden, 2022](#); [Baisden et al., 2022](#)). However, **we still lack relevant, consistent and longitudinal data on the communities of people that enter, leave, and remain in, our national RSI system, and how this has changed over time (e.g., the thus-far underused New Zealand Research Information System, NZRIS).**

To rigorously address the questions posed in Te Ara Paerangi, we first need to examine the existing system: who sits within and outside it, and who is enabled in, and disabled from persisting in it? Where do connections exist, and where are they absent or lacking?

Here we emphasise some of the evidence that we have collated and visualised from sources such as Education Counts ([Ministry of Education, 2022](#)), and the PBRF, that underpin our submission. These data suggest that greater investment and a different approach is required throughout the NZ education and research system.

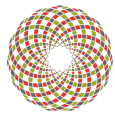
The imperative “to make scientific communities and institutions healthier, fairer, and more inclusive” ([Almeida-Souza & O’Brien, 2022, pp. 177](#)) emphasises systems that prioritise areas of academic life that have seen sustained and serious neglect, particularly for precarious early career researchers (ECRs) and academics with diverse backgrounds.

These areas include system negligence around mental health ([Duffy et al., 2021](#); [Satinsky et al., 2021](#)); access to information, systems, and remuneration (including basic benefits) that enable them to flourish in their endeavours, and diversity in the workplace. Research careers can often be difficult on whānau, especially for researchers with young children.

Base funding proposals, fellowships, paid-parental leave policies, and other changes that rebalance support enable the success of the research workforce represented by these values, and shared principles enable self-organising collective management of shared resources.

PhD students

- PhD stipends have been below minimum wage since 2014 ([Soar et al., 2021](#)), and median time to completion is 4 years for all disciplines.
- The number of doctoral enrolments in Aotearoa New Zealand each year is growing at a much faster rate than completions ([Patel et al., 2022](#); [Stewart, 2022](#)). The number of PhD students in total has doubled since 2008. (Education Counts), but domestic student numbers have been largely stable since 2008.



- In the natural and physical sciences, over the ten years from 2010-2020, domestic completions dropped from 190 to 150, and international completions tripled (Education Counts data, RSTA briefing paper 2020). A drop in domestic, and an increase in international student completions was similarly observed for engineering and technology.

Graduates

- There is a persistent oversupply of PhD graduates relative to demand in long-term roles for the types of roles for which graduates have been prepared and wish to pursue (Patel et al., 2022; Royal Society Te Apārangi, 2020; Stewart, 2022).
- Employment rates for people with PhDs decreased from 85% in 2006 to 77% in 2018 (Royal Society Te Apārangi, 2020).
- Of domestic graduates, in recent years around 71% of these have identified as NZ European, 9% Māori, 4% Pacific, and 17% Asian (Royal Society Te Apārangi, 2020), although these figures have not remained static through time (Figure 4).

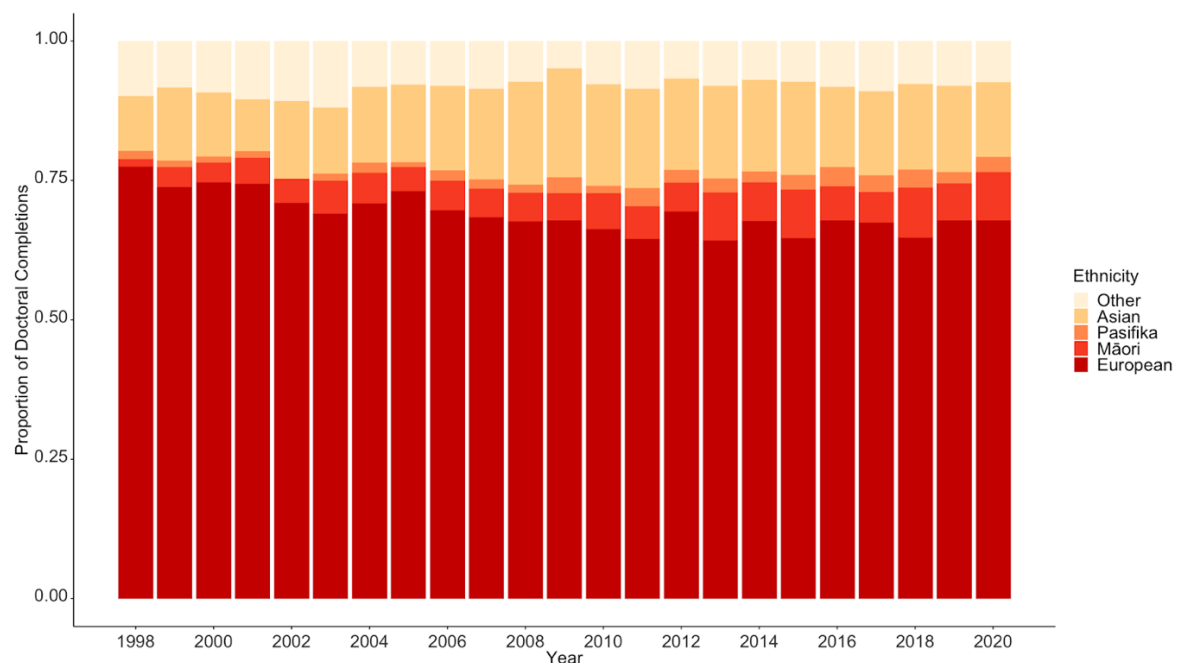


Figure 4. Proportion of domestic student doctoral completions by ethnicity, showing a proportional decrease in 'European' completions, but a proportional increase in Maori, Pacific peoples and Asian completions over the 22-year time period from 1998-2020. Data from Education Counts.

The workforce

Universities recruit in an international labour market. Academic jobs in Aotearoa New Zealand are limited, and currently around 50% of positions are thought to be filled by academics from overseas. International academics appear to be strongly over-represented given their proportion of the total New Zealand population (PBRF, Scarf and Waitoki, unpub. Data, Figure 5).

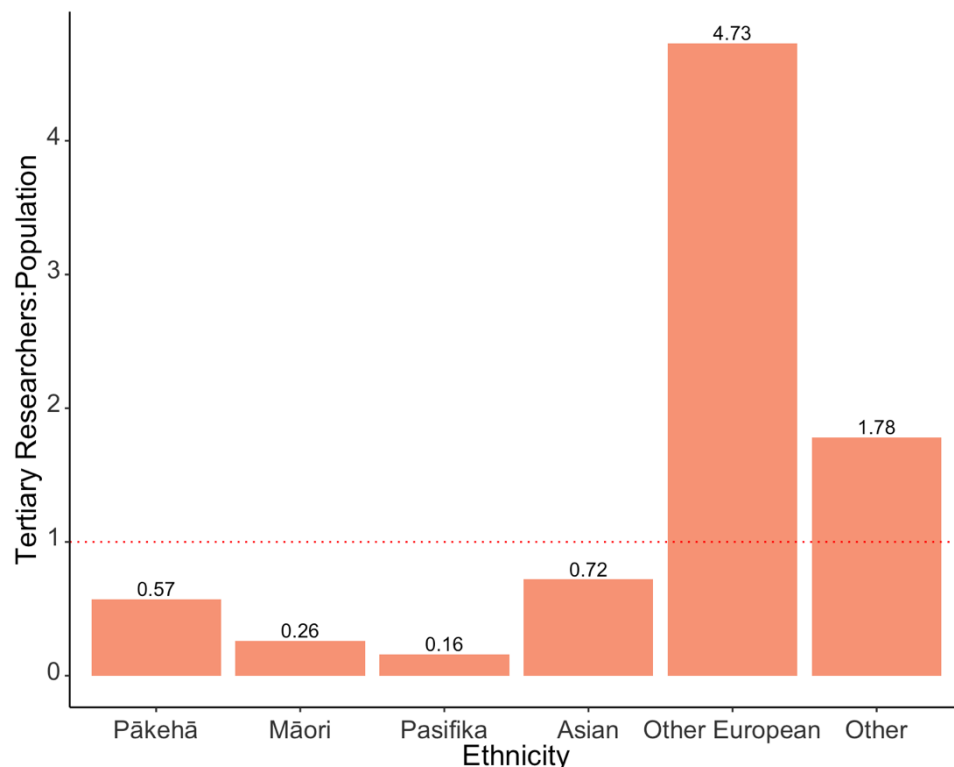
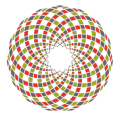


Figure 5. PBRF ethnicity data shows that people living in Aotearoa New Zealand and who identify as 'European' are many times more likely to be employed as university researchers, relative to their proportion of the New Zealand population, when compared to people who identify as Pākehā ('New Zealand European'), Māori or Pacific people. Pacific peoples in particular are strongly under-employed as university researchers. As yet it is unclear how gender interacts with these data. (unpublished PBRF data, D. Scarf).

- Māori are around 5% of those employed as researchers in universities. Māori are therefore around 10% of the domestic graduates who are employed as researchers in universities (unpub. PBRF data, D. Scarf), and also around 10% of domestic PhD completions.
- New Zealand Pākehā are around 38% of the university workforce (unpub. PBRF data, D. Scarf).
- Participation in the RSI system by Pacific peoples is much lower than might be expected from graduate numbers, as observed from the Education Counts and PBRF data, and we infer there are particularly strong intersectional barriers for Pacific peoples that require urgent attention and action.

Education Counts data are also represented below, although we note the poor category labelling in this dataset (Figure 6).

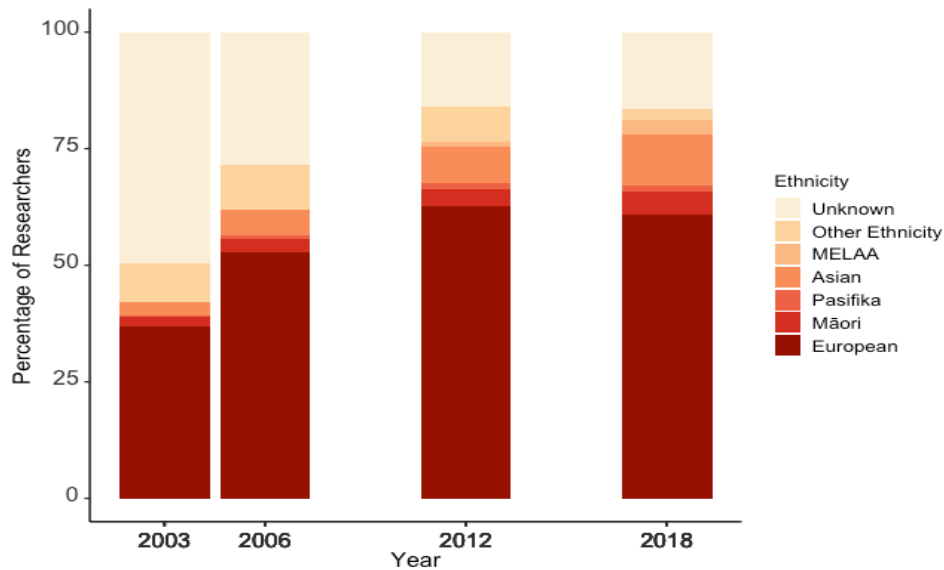
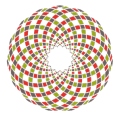
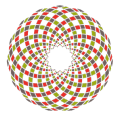


Figure 6. Māori, Asian and Pacific researchers grew as a percentage of the RSI workforce between 2003 and 2018, with the percentage of 'European' researchers likely similar through time periods. Data do not reveal how many of these researchers represent domestic enrolments.

- Crown Research Institutes (CRIs) anecdotally note a lack of competitive applications from domestic applicants, leading to hiring from overseas ([Royal Society Te Apārangi, 2020](#)). CRIs are often looking for applied scientists with a motivation to solve Aotearoa New Zealand's pressing issues. This suggests a need for increased inter-disciplinary PhD topics and experiences that connect students with communities, government and business, and for inter-disciplinary research, such as that undertaken by CoREs such as Te Pūnaha Matatini.
- Māori, Pacific peoples, and women are among those who are disproportionately excluded from the research pipeline after PhD completion. We note that many in these groups may not have the mobility to take up overseas postdoctoral fellowship opportunities because of family or community commitments, or alternatively their work may be best done from Aotearoa New Zealand, in an environment where there is limited funding and few opportunities for postdoctoral fellows.
- The Rutherford Discovery Fellowship scheme has had limited success in attracting Aotearoa New Zealand researchers back from overseas, and many fellowships are awarded to international PhD graduates or postdoctoral fellows (which might be expected as international graduates accounted for around half of PhD students in 2020, although the scheme is limited to NZ residents). It does however also suggest a mismatch between domestic secondary and tertiary education, and research excellence and leadership. While Māori and Pacific graduates have been notably present in the last five years of Rutherford Discovery Fellowships, other domestic graduates, such as New Zealand Pākehā women, have not fared well.
- Education reports, such as the Expert Advisory Panel on Mathematics and Statistics in Aotearoa New Zealand schools ([Royal Society Te Apārangi, 2021](#)), speak eloquently of the need for high quality teaching in schools / kura if we are to have appropriately qualified Aotearoa New Zealand researchers in the RSI system.
- Excluding opportunities for strategic investment in new scholars (e.g., cohort hires), recruitment is largely dependent on retirements. Given uneven age distributions across disciplines (e.g., Figure 7), some may be less able than others to respond to



equity issues within the research system. The age structure within CRIs, and more broadly within the RSI system, deserves examination and planning.

- We suggest that, in order to create opportunities for less experienced researchers, late career researchers (for example, those 67+ years), for example, could act as Associate Investigators rather than Primary Investigators on grants.
- In some STEM disciplines, the academic workforce is relatively young, in contrast to overseas examples showing an aging workforce. Mid- and late-career researchers have an important role in mentoring and connecting. Business research and development growth, which has been employing few PhD-qualified researchers, provides an important focal point to support new careers as well as connectivity and mentoring (Baisden 2022).

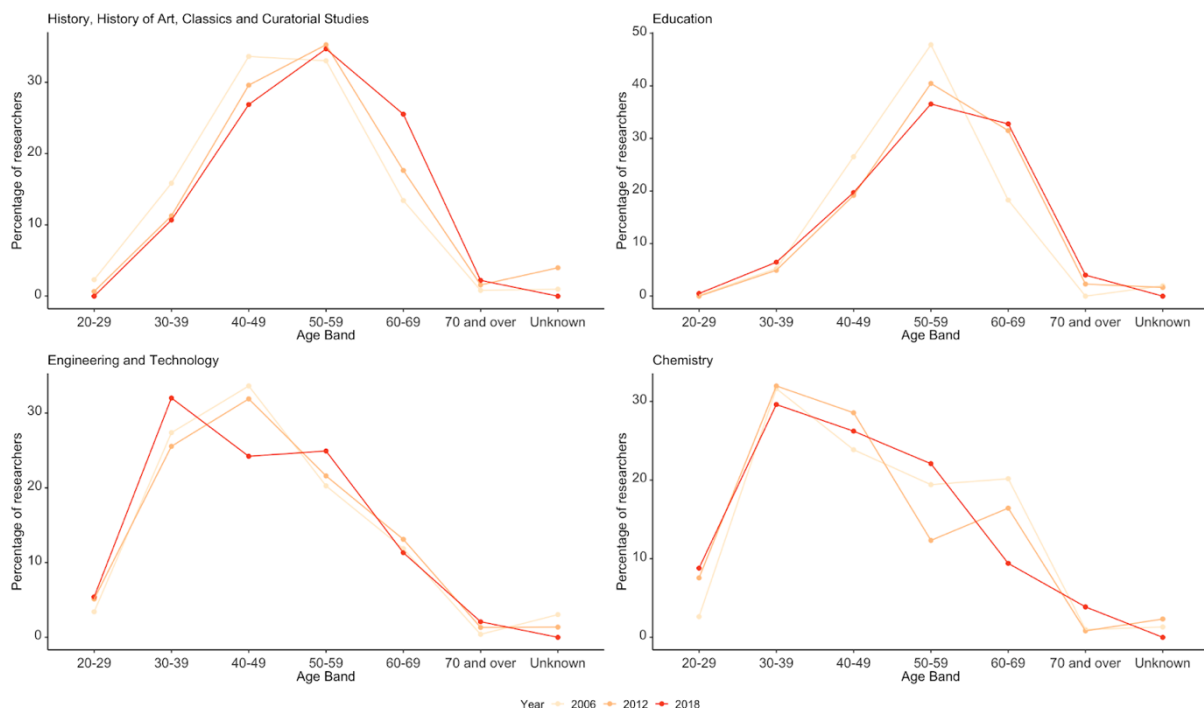


Figure 7. Opportunities for recruitment of new scholars are likely to be variable across different disciplines. We show age bands in four subject areas, representing the periods 2006, 2012 and 2018 (Education Counts data). Disciplines are (a) history (b) education (c) engineering and technology and (d) chemistry. History, history of art, classics and curatorial studies, and education, have a much older workforce compared to chemistry, and engineering and technology.

We also note that considerable gender disparities also remain (Figure 8).

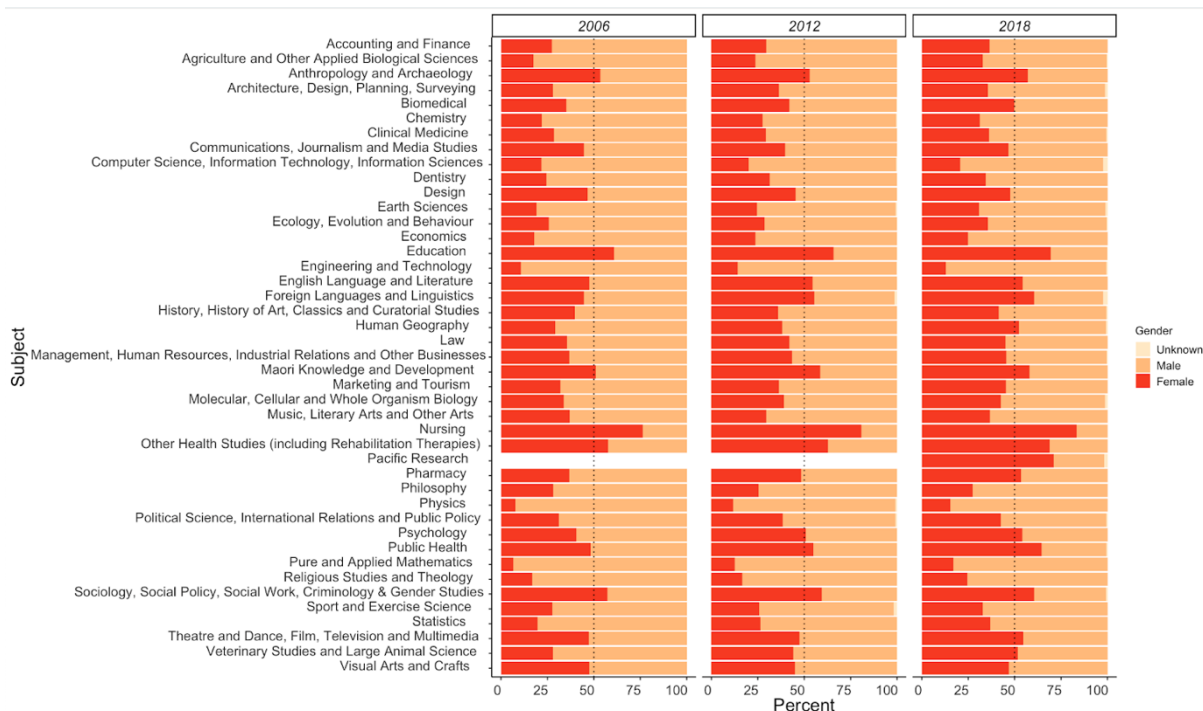
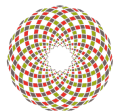


Figure 8. Women remain under-represented across most university disciplines (Education Counts data). The dotted line represents gender parity between men and women. We emphasise that presentation of these data is based on what is currently known and available, and we acknowledge that the gender of some people is not represented here.

Amplifying trust

In conclusion, amplifying all efforts of the research workforce to build trust—through reciprocity and collaboration to generate net benefits through collective action—is worthy of support (Figure 9). It will be an important national journey, taken together, to make Te Ara Paerangi Future Pathways a success.

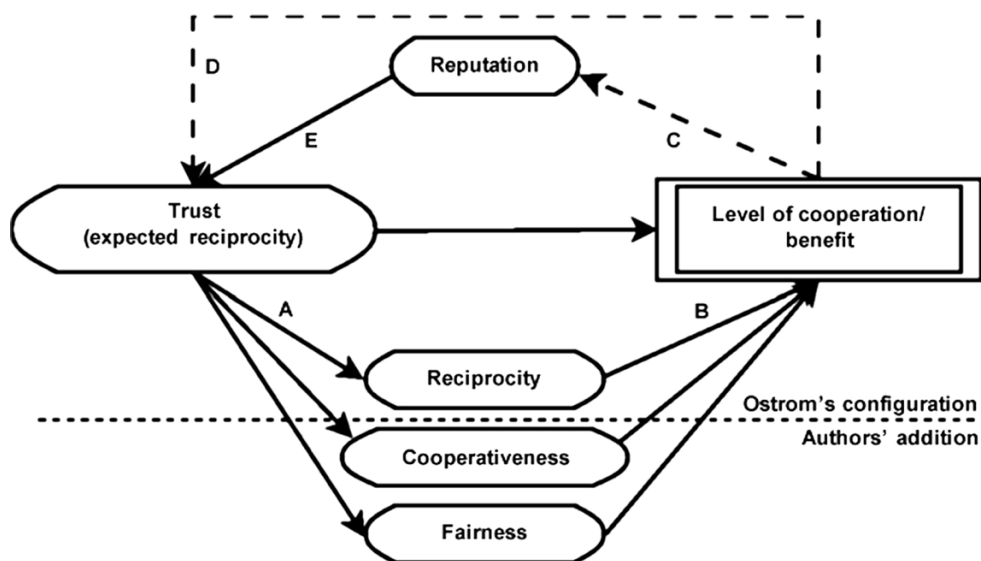
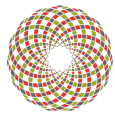


Figure 9: A 2009 extension to Ostrom's Nobel Prize winning theories describing how to overcome dilemmas through cooperation.



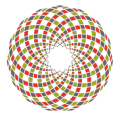
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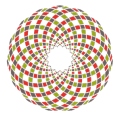
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