Poutū-te-rangi March 2022

Te Ara Paerangi - Future Pathways Green Paper Submission

Royal Society Te Apārangi

Ruia taitea, kia tū ko taikākā.

Shed those outer layers and
reveal your internal courage.

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Ko Wai Tātou? Who Are We?

Royal Society Te Apārangi is an independent, not-for-profit organisation. We operate under our own private Act of Parliament to advance and promote the humanities, technology and science in New Zealand. We are inter-generational, with a history dating back to 1867.

We occupy a unique position within the research, science and innovation (RSI) system, with our unparalleled breadth and depth of local and international networks and connectivity, and activities that span the disciplines. Our membership and networks include eminent scientists and scholars, research professionals and RSI-system leaders.

We invest the prestigious Marsden Fund and a range of fellowships and scholarships on the government's behalf, and we provide advice on important matters to the community and government. We celebrate excellence and success with prizes and awards.

With these attributes, the Society brings a well-informed and independent view of how the RSI system can best contribute to New Zealand's future through Te Ara Paerangi - Future Pathways.

We applaud the government's openness to hearing a wide range of perspectives in its consultation and we also look forward to being part of the continuing conversation as the anticipated "white paper" is developed. We have focused on those areas where we can add value through our independent perspective. The Society's Council has approved this submission.

Kōrero Tīmatatanga Preliminary Comments

We support the vision of a research, science and innovation system that is "adaptable for the future, resilient to changes and connected – to itself, to industry, to public sector users of research, and internationally".

Our starting point is to acknowledge that the current RSI system, much of which has endured for the past 30 years, has delivered considerable benefits to the country. Examples include recognised global excellence in many areas of research, science and technology; successful new global companies; and our ability to respond to major crises such as PSA and *Mycoplasma bovis*, earthquakes and other hazards, and the current COVID-19 global pandemic, to name just a few. This has only been possible with long-term public investment in RSI capability development.

Notwithstanding these successes, there are important issues to address. We have a system that is not fully inclusive, with an excessive focus on competition over collaboration, precarity in parts of the workforce, and lack of a long-term approach to investment in critical infrastructure and related support services. The lack of a Te Tiriti-based partnership with Māori needs to be addressed, along with continuing under-representation of Māori and Pacific researchers and communities, and under-representation of women throughout the system.

We note that whilst we are heartened by an emphasis in Te Ara Paerangi on Te Tiriti o Waitangi, mātauranga Māori, rangahau Māori and Māori researchers, the importance of Pacific research and the contribution of Pacific researchers to advancing our knowledge effectively receives minimal attention. In addition, we also note the critical role social sciences and the humanities play in contributing to the diversity of knowledge needed to address the big global challenges in a human-centred way.

In proposing change to the RSI system, suggested to be the biggest in some time, we urge the government to assess change in terms of achieving greater benefits and outcomes for New Zealand. This should be informed by a thorough understanding of the rationale and principles that have guided the current RSI system and avoid, where possible, the costs of disruptive change and loss of capability.

Change must be made with a clear intent in mind and an assessment of the impact on people, their health and wellbeing; their economic, environmental and social aspirations; and the costs and benefits to New Zealand.

A whole-of-system approach

It is well recognised globally that research, science and innovation are not externalities to an innovation system. In practice that means that we cannot simply "buy in" our knowledge from overseas, and that the activities that generate RSI benefits within New Zealand are part of a much wider system of connected activities and incentives.

Several system-wide principles and obligations that sit above the individual themes in the consultation are set out below. Any proposed changes should be tested against these principles and obligations, as well as the consequential impact on other parts of the system.

Human capital development

New Zealand contributes but a small fraction of total global knowledge. It follows that a necessary outcome from RSI activity is to build human capital that directly benefits New Zealand and enables the transfer and absorption of global knowledge for use here and abroad.

Building intellectual capital, enhancing economic and social outcomes, and improving health and wellbeing of people and the environment are some of the additional outcomes required.

Further, our future RSI system needs to reflect that New Zealand is part of a global labour market and to be deliberate about how investment in RSI will enhance growth in our human capital in a way that increases long-term benefit for New Zealand. This will need to include looking outside the RSI system itself and considering, for example, the role of immigration and labour market policies, ICT and large infrastructure policies and business incentives.

It is worth noting also that RSI capability is lost much more quickly than it is gained. Building world-class capability and achieving impact from it can take decades. While a system with flexibility and agility is an attractive prospect, and one we should aspire to, there may be a trade-off with the stability and certainty necessary for long-term mission-led research and human capital development.

The Society supports initiatives that would help lessen reliance on competitive funding alongside alternative mechanisms to drive agility in the system. Agility in the system must not come at the expense of support for long-term infrastructure and activities that sustain research. To be effective, this would also necessitate devolving some decision-making to the appropriate institutions where the information advantage on capability trade-off lies.

Overall, any proposed changes in the current RSI system should be evaluated against their ability to enhance the growth of New Zealand's human and intellectual capital in RSI and avoid any unintentional destruction of existing capability.

The right to science and its benefits

The freedom to participate in, and benefit from, scientific research is a universal human right [1]. This is articulated in the 1948 Universal Declaration of Human Rights (UDHR) [2] and the 1966 International Covenant on Economic, Social and Cultural Rights (ICESCR).

These refer to, among other things, the right of everyone to freely participate in cultural life, the right to enjoy the arts, and the right to share in and benefit from scientific advancement. New Zealand ratified the ICESCR in 1978 [3] and is bound by international obligation to respect, protect, and fulfil the right to science [4].

In achieving these aims, States are also obliged to conserve, develop and diffuse science and culture, to respect the freedom indispensable for scientific research and creative activity, and to recognise the benefits to be derived from the encouragement and development of international contacts and co-operation in the scientific and cultural fields.

New Zealand is fortunate to be among democratic countries with modern RSI systems that operate consistently with these obligations. It is imperative that New Zealand at least preserves what it has, as well as enhancing this in the future. This should recognise, for example, the importance of minimising political influence in RSI decision-making, maintaining strong institutions to house and foster human capital development, devolving decisions to where the information advantage lies, promoting freedom of expression within appropriate bounds, along with efficient and effective use of taxpayers' money, and a strong ethical basis to all RSI activities.

Te Tiriti o Waitangi

Honouring our obligations under Te Tiriti o Waitangi is an area where our current RSI system falls well short.

The Society strongly supports efforts to address this shortcoming, noting that this is likely to require changes in the way the system considers, for example, excellence, impact and recognition within its investment processes. We offer further suggestions about this later in this submission.

Inclusion and diversity

Inclusion and diversity in our RSI system are also fundamental to New Zealand meeting its obligations to ensure all in its communities can contribute to, participate in and seek benefit from research, science and innovation.

This is another area where our current RSI system falls short, recognising that New Zealand is a highly diverse country and there is need to accommodate multiple knowledge systems.

In particular, the future RSI system should better acknowledge and value our obligations to and relationships with our Pacific communities here in New Zealand and within the Pacific Region. New Zealand shares a rich history with its Pacific neighbours and there is valuable work and progress to be achieved together.

Freedom and responsibility

The necessity for freedom and responsibility of researchers and for public trust in research and research organisations through effective community engagement should be explicitly acknowledged and addressed as part of a global best-practice research system.

According to the authoritative interpretation of the right to science adopted by the UN Committee on Economic, Social, and Cultural Rights in 2020 [5], scientific freedom entails

> *"The protection of researchers from undue influence on their judgment; the possibility for researchers to set up autonomous research institutions and to define the aims and objectives of the research and the methods to be adopted; the freedom of researchers to freely and openly question the ethical value of certain projects and the right to withdraw from those projects if their*

conscience so dictates; the freedom of researchers to cooperate with other researchers, both nationally and internationally; and the sharing of scientific data and analysis with policymakers, and with the public wherever possible."

The International Science Council's *Principle of Freedom and Responsibility in Science* [6] states, among other things, that the free and responsible practice of science,

"in all its aspects, requires freedom of movement, association, expression and communication for scientists, as well as equitable access to data, information, and other resources for research."

Scientific freedoms go hand-in-hand with responsibilities. The 2017 UNESCO Recommendation on Science and Scientific Researchers [7] outlines responsibilities that scientists must uphold in the pursuit of scientific knowledge, as well as the responsibilities of States in governing national science systems.

Research integrity and engagement/partnership are a fundamental necessity for public trust in research, science and innovation. The ability to uphold the free flow of ideas and information, as well as fostering an open, informed debate on matters of public interest, is central to building and maintaining a democratic and inclusive society.

Further, citizens expect to participate in discussion and debate on important public issues. Better supported, therefore better-informed communities, that are comfortable with research and new and innovative ideas, will have greater capacity and capability to critically assess and absorb new knowledge, and make well-informed decisions [8].

Researchers, as members of a professional community, have an implicit obligation to act in society's long-term interest through the integrity of their work and engagement. Researchers who fail to display professionalism may contribute to damaging the trust of the public and communities in the value of research more generally. Engaging with the public and communities in a way that is respectful and builds trust through professionalism and transparency will benefit the wider research community, and in turn facilitate stronger relationships with the public and greater use of shared knowledge in the public interest [8].

Professional standards and ethics for New Zealand

These obligations, freedoms and responsibilities provide a basis for setting professional standards and ethics as a foundation for New Zealand's RSI system.

The Society supports this through maintaining a Code of Professional Standards and Ethics in Science, Technology and the Humanities [9] [10] for its members, which also gives effect to Te Tiriti o Waitangi through a foundation of bicultural ethical principles.

Within this Code is a set of values and principles that all members of the Society must abide by. These same values and principles are also contained within the Research Charter for New Zealand, to promote the conduct of research to the highest standard of ethics and integrity and to produce high-quality research findings. The Charter is available to any organisation to adopt [11].

These values reflect the need for social responsibility in the research community – attunement to the needs and aspirations of our communities; ethical research practice; respect for the public interest above private interests of researchers, research organisations or end-users of research; and the idea that publicly funded research is a public good. The latter is also encapsulated by the International Science Council in their vision for science as a global public good [12].

The uniquely New Zealand values and principles could serve as a useful foundation in the future RSI system [9].

> *"The ethical and professional values and principles relevant to the research community must be interpreted within a general framework that recognises human and civil rights, the principles of free enquiry and an open society, and obligations arising from the Treaty of Waitangi. These principles and values share a common ground: processes for knowledge discovery, exploration and sharing between researchers, participants and communities in Aotearoa New Zealand that are respectful of people and their rights."*

These principles are: tika[1], mana[2], whakapapa[3], manaakitanga[4], pūkenga[5], kaitiakitanga[6], justice[7], duty of care[8], beneficence[9], non-maleficence[10], respect[11], and integrity[12].

It is important to note that the Research Charter and the Code recognise the value and validity of multiple research practices (including kaupapa Māori, rangahau and Pacific research practice), multiple knowledge systems (including mātauranga Māori), and te reo me ōna tikanga.

The Society would like to see these principles and standards expressed more explicitly in the future RSI system, including within government where it is involved in setting RSI investment.

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[1] Tika means acting with integrity and respecting the interests of relevant communities.

[2] Mana means balancing one's own authority and the rights held by others

[3] Whakapapa acknowledges the importance of relationships with relevant communities

[4] Manaakitanga means actions that are mana enhancing to all those around us, demonstrating kindness, equality, respect and thought for others; acting with care and respecting diverse values and communities

[5] Pūkenga means acting with rigour

[6] Kaitiakitanga means to nurture and guard all people and their place, employ resources wisely, ensuring that their use contributes positively

[7] Justice requires that people are treated fairly and equitably, including fairly distributing the benefits and burdens of research to individuals and communities

[8] Duty of care describes the obligations that a reasonable person owes to others who may be affected by their acts or omissions

[9] Beneficence means acting to benefit other people, contributing to broad concepts of wellbeing, and balancing benefits against risks and costs

[10] Non-maleficence means not causing harm intentionally, and ensuring that the risks of harm are outweighed by the expected benefits

[11] Respect for persons means respecting an individual's right to make choices and hold views, and to take actions based on their own values and beliefs

[12] Integrity refers to the trustworthiness of research due to the soundness of its methods and the honesty and accuracy of its presentation

International and national collaboration and connectivity

In ratifying Article 15 of the ICESCR, the government recognised the benefits of international collaboration in the pursuit of knowledge. The priorities for New Zealand's RSI system must reflect the globalised nature of contemporary society.

General Comment No.25 calls for States to "*foster the development of international contacts and cooperation in the scientific field, without imposing restrictions on the movements of persons, goods and knowledge beyond those that are justifiable in accordance with article 4 of the Covenant*" (para. 52) [3].

New Zealand appears to do relatively well in meeting these obligations, reflecting our small size and the necessity of staying well connected to the rest of the world, and we support maintaining and enhancing our international relationships. New Zealand shows strong researcher-to-researcher connections in publications, both nationally and internationally. Marsden-funded university research is very international [13].

However, improving connections between researchers and communities within New Zealand is vital for ensuring ongoing trust in science and technology [14]. The impact of research, science and innovation can be enhanced through supporting respectful co-design and/or co-determination practices. If the end user or a particular community is also a part of the entire research process, higher-impact research outcomes are more likely.

Kaupapa Tuatahi Ngā Whakaarotau Rangahau
Theme 1 Research Priorities

The Society agrees that our current system lacks clearly articulated priorities at a system level and that the priority-setting landscape is fragmented.

New Zealand lags behind many comparable countries in its overall investment in research, science and innovation. Government currently has a target of 2% of GDP for total RSI but in recent years has been silent on its commitment to increased expenditure on publicly funded research, science and innovation. Priority setting lies at the heart of deciding where any additional or reprioritised public spending on RSI should go.

The following are some considerations and principles that we view as important when determining the scope and focus of research priorities and to guide the national research priority-setting process. The comments address all three of the questions raised in this theme collectively.

The Research Science and Innovation system is more than research

The Society recommends taking a systems approach to setting priorities so that they encompass a range of necessary functions and activities within the RSI system that have a call on public investment. Such priorities are broader than research priorities per se.

For example, priorities in the RSI system should acknowledge the infrastructure that is needed to carry out and gain impact from research, which is a valid part of the research investment. This includes, for example, data collection, monitoring systems, development of software tools, relationship building, and curating and transferring knowledge.

Priorities should also acknowledge the significant support workforce that is needed to deliver and gain impact from research (realising the value of human and intellectual capital). For example, the technical workforce and, in turn, the career pathways that attract people to this work, where the primary driver is not research but testing – such as clinical diagnostic laboratories, or environmental testing laboratories, or Geonet.

These all provide critical services to the RSI sector and to New Zealand and are just as important "priorities" as the research and other work that may access or inform them.

Knowledge transfer and commercialisation are also equally important priorities.

The point here is that there are many functions in the system that need to be simultaneously supported to maximise benefit and these may be operating on different time scales and with different demands on investment—and, indeed, the priorities will interact with each other. In this context, it is very unlikely that a set of national research priorities would be found that would cover all these needs in the system via a single mechanism. It may be that previous attempts at mechanisms to define research priorities in such a way have not endured because of this.

A more nuanced approach is required, one that acknowledges that different sorts of priorities will require different approaches and mechanisms, and decisions about priorities may be made in a multitude of places within the RSI system. The remainder of this section sets out some principles and approaches that articulate this more fully.

Setting priorities with the outcome in mind

Priorities of the RSI system need to be considered with the societal ends in mind.

Publicly funded RSI is a means to an end rather than serving only the RSI system itself. For example, RSI supports Predator-free New Zealand, Carbon Zero, addressing biodiversity and poverty, the United Nations Sustainable Development Goals, freshwater quality and other environmental and health goals for the country.

The United Nations Sustainable Development Goals are also an example where our international obligations intersect with New Zealand's own priorities. Meeting our international obligations must be considered as part of setting priorities in the RSI system.

In meeting the Sustainable Development Goals, the International Science Council has identified five research priorities to drive sustainable societal transformation to address the most important challenge of the 21st century— "advancing human development while respecting planetary boundaries" [15].

- "Food: eating adequate, healthy diets without consuming nature's bounty
- Water: replenishing nature's reservoirs to provide enough clean water for all
- Health and wellbeing: being whole and well in body, mind and nature
- Urban areas: thriving in places while stewarding the natural environment
- Climate and energy: shifting to clean energy while restoring a safe climate." [15]

The outcome priorities of New Zealand's RSI system could usefully acknowledge these sustainable development goals along with managing our international interests and obligations in the extended continental shelf, the Pacific Region and parts of Antarctica, and addressing our contribution to the decline in biodiversity.

It follows that the process of working out and prioritising the RSI input into meeting these societal goals needs to start with governments, working on behalf of taxpayers and citizens, to set direction, vision and priorities. Lack of this high-level direction or vision will make it difficult to set stable and clear priorities at other levels in the system.

Longevity must be an important objective of priority setting. Many aspects of discovery and application in the RSI system take a generation to fully come to fruition and have impact. Human capital developed in RSI is also characterised by the need to stand on the shoulders of previous experts to generate new knowledge, and in doing so draw on different disciplines and skill sets. This necessitates the development and maintenance of sustainable long-term relationships that "oil" the necessary connectivity within the RSI system, both within New Zealand and internationally.

High-level direction setting will thus work best in the country's long-term interests if Parliament acts in unity, in a non-partisan way, in agreeing the high-level direction and vision for the country's long-term RSI investment needs.

The Society supports creation of a suitable mechanism that would bring together government, private sector and non-government interests to set high-level outcome priorities for the RSI system.

Translating the high-level direction into strategy and priorities

The Society believes that decisions about translating high-level outcome priorities into RSI priorities and activities should be made where the information advantage lies within the system.

Further, the research strategies developed to deliver on high-level outcome priorities need to recognise that different pathways to impact require diverse types of support from RSI. Relying on a single mechanism is unlikely to be effective and efficient in setting all strategy and RSI priorities across these areas.

For example, mission-led research supporting environmental, health or social outcomes may require different prioritisation mechanisms than, for example, industry-driven research serving economic outcomes, or technology start-ups, or investigator-initiated blues skies research such as the Marsden Fund, providing fresh and innovative ideas.

These are just a few examples. The Society suggests that consideration be given to how priority-setting mechanisms can reflect the specific characteristics of their pathway to impact and the appropriate knowledge required to make decisions.

The role of government agencies

Government agencies with outcome responsibilities, such as Ministry of Primary Industries, Ministry for the Environment (MfE) and Department of Conservation (DOC), have an important role in informing 'upwards' the setting of the high-level outcome priorities and 'downward' - working with research system leaders in the appropriate areas to translate these into research strategies against which funds can be allocated.

This is well illustrated by the Parliamentary Commissioner for the Environment in his recent reports identifying the need for more strategic governance and environmental research priority setting, including a significant role for MfE, and proposing a strategic investment agency (separate from the Ministry of Business, Innovation and Employment (MBIE)) to set priorities and allocate funds with the appropriate knowledge to do so [16].

A characteristic of our current RSI system is that the funder (MBIE) plays a significant role in priority setting. The limited involvement of other government agencies in setting priorities is a potential gap in the system. The Society supports further exploration of options for increasing government agencies'

influence in strategy setting for the RSI system, provided the mechanism for subsequently allocating funds against strategic objectives remains independent of government.

Institutions are an important part of the priority setting mechanism

Institutions that have an information advantage also play an important role in translating agreed strategies into research priorities.

For example, CRIs that are stewards of important infrastructure and long-term programmes of work; universities and wānanga at the leading edge of new knowledge generation and teaching; researchers and scientists themselves.

Institutions also play an important role in providing safe and secure environments for researchers and scientists to work in, along with mechanisms for flexibility and agility, albeit within the constraints of their contractual relationships with MBIE and other funders. An example was the agile response of Plant & Food Research to the kiwifruit PSA crisis that saw a significant internal adjustment of their research programmes to successfully address the issue.

Most, if not all, developed countries have a mechanism to address mission-led research and provide stewardship of important long-term infrastructure. This is often in the form of government laboratories like New Zealand's previous Department of Scientific and Industrial Research (in existence until the early 1990s). In New Zealand's case, the CRIs were created specifically to reflect critical strategic priorities that serve this country's long-term interests, or so at least they were deemed to be at the time they were created. It is hard to argue that primary production, hazard management and environmental health are not long-term priorities for New Zealand.

The CRIs' mandates and structures reflect the necessities of long-term relationship and capability building in their mission-led areas, including having that capability available when urgent priorities such as earthquakes, floods and pandemics arise, or to support the country's economic growth objectives. New Zealand's effective response to earthquakes, floods and COVID-19 has not come about by accident but has been supported by long-term investment in capability and relationships.

The Society notes the importance of strong institutions in the future RSI system, especially around mission-led research and infrastructure with long time horizons.

Equity in priority setting

Equity is an essential principle for guiding the process by which priorities for the RSI system are established, as well as in determining the scope and focus of these priorities.

In practice, this involves mitigation of all forms of discrimination based on factors such as ethnicity, religion, language, opinion, sex, gender identity, sexual orientation, disability, or age.

Priority setting also needs to reflect the specific approaches of Māori and Pacific communities which include, for example, more emphasis on respectful and meaningful community engagement and

interactions, more involvement in the establishment phase of research and a whānau-based approach to delivering it and recognising excellence and impact.

New Zealand-centric elements when setting priorities

Aside from alignment with key international obligations, priority setting could be usefully aligned with the Living Standards Framework [17], including recognising human and intellectual capital as the value created from research, science and technology, and also from an indigenous approach to such a Framework [18].

New Zealand can become a world leader on any subject in which we have been able to cluster resources around a research group that is making major advances in human and intellectual capital creation in the field. Trying to pick such areas strategically and make them happen may not serve us well, unless there is a particular reason the area is "sticky" to New Zealand (for example, earthquake and seismic research due to the risk such geological hazards pose to our nation) or relates to a resource where this country already has an intrinsic competitive advantage.

A superior approach is to have systems that quickly identify where a world leadership role is possible and then invest to grow the relevant group and provide them with suitable resources. Such an approach also needs to recognise when our advantage is gone and be prepared to abandon those areas in favour of new emerging ones.

Balanced knowledge generation

Any priority-setting process needs to be considered a balance of creating new knowledge and the extension, maintenance, use and deployment of existing knowledge to meet our future national needs.

New Zealand needs a balanced portfolio of discovery, translation and implementation and the right balance between agility and stability in the system.

Discovery projects would probably be at the global knowledge frontier as future applications may be speculative. On the other hand, a project with a mission to, say, map New Zealand's biodiversity within its continental shelf would aim to provide new knowledge, some of which will add to existing knowledge, while there would also need to be investment in the infrastructure to support it, such as data curation and taxonomy.

Evaluation and horizon scanning to support priority setting

Evaluation of the impact of research already done can be used to inform priorities, as can the use of foresight and horizon scanning to identify future trends and needs.

Both mechanisms should inform the mechanism for high-level priority setting referred to previously in this section.

Kaupapa Tuarua Te Tiriti, Mātauranga Māori me ngā Wawata o te Māori

Theme 2 Te Tiriti, Mātauranga Māori and Māori aspirations

Royal Society Te Apārangi strongly supports a Tiriti-led, equitable and co-designed science and research system, in development and execution, that fully recognises, acknowledges and highly values mātauranga Māori, a knowledge system unique to Aotearoa, alongside other knowledge systems.

The Society is both defined by and distinctive in its tūrangawaewae—in particular, our location in the māra garden of Pipitea Thorndon, Wellington, New Zealand, and in the Asia–Pacific region. For more than 150 years, Royal Society Te Apārangi has had a companionship – relational and transactional – with mana whenua, tangata whenua and mātauranga Māori.

Following the request to respond to the Green Paper, we continued to consult with rōpū Māori from varying regions, sectors, and organisations, including Māori within our membership. These rōpū are very diverse with many different priorities and concerns. We are listening, hearing and learning, developing our way forward from understanding our various experiences, discussions, aspirations, issues and solutions – in a collaborative and co-designed approach.

We have a sincere commitment to assist in fulfilling Māori aspirations within the transformed RSI system, including supporting career pathways, workforce development, resource allocation, equitable investment, indigenous innovatively led initiatives, and where mātauranga Māori is acknowledged and protected across these all.

Such recognition is an important aspect of our maturity as a nation, achieving an equal partnership as Te Tiriti envisages, adding richness to what we contribute and ensuring better outcomes for all of Aotearoa New Zealand.

The sector must not continue to treat mātauranga Māori as an add-on to an existing system. Specific incentives and considerable support for change will be needed along the way, with regular reflection and a strong principle of co-design and collaboration.

New Zealand also has an opportunity to provide global leadership in developing an RSI system that recognises multiple knowledge systems and ways of knowing, inherent in the International Science Council's Principle of Freedom and Responsibility in Science [19], from the Committee for Freedom and Responsibility in Science (CFRS), UDHR and the ICESCR.

Q4 Te huarahi e marohitia ana
Engagement - How would you like to be engaged?

Engagement needs to be guided through wānanga and by a robust co-design process enabling exploration of kaupapa ideas and development.

There is a spectrum of Māori engagement. It is vital to have significant engagement with Māori[13] (e.g., wānanga, co-design, governance roles etc) where Māori interests are significantly affected, or are self-evidently compelling, or where those interests are central and other interests are limited.

We agree that in guiding this process consideration needs to be given to the diverse ways in which Māori organise themselves.

Ministry of Business, Innovation and Employment Hīkina Whakatutuki has a Tiriti responsibility to undertake meaningful engagement, as outlined in the Crown Engagement with Māori framework, guidelines and engagement strategy from Te Arawhiti The Office for Māori Crown Relations.

Te Tiriti o Waitangi in practice

What does this look like in practice? There must first be recognition of the mana whenua and kaumātua. Secondly, there needs to be the practice of tikanga and kawa, strengthening te ao Māori. Thirdly, mātauranga needs to be uplifted through co-developing and co-designing programmes with iwi, hapū, hapori and whānau. Community-led research programmes need to be central in the evolving RSI system as these will help realise Māori aspirations and provide greater equity in outcomes.

In delivery of all kaupapa, Te Tiriti o Waitangi in practice is guided by the Articles:

1. **Kāwanatanga**: Processes, actions and decision-making are informed and shaped by the worldviews and perspectives of both tangata whenua and tangata Tiriti. All work is in partnership with tangata whenua.

2. **Tino Rangatiratanga**: Tangata whenua-led processes, actions and decision-making are supported through sharing power and resources.

3. **Ōritetanga**: Specific actions are undertaken to ensure equitable outcomes for tangata whenua.

4. **Wairuatanga**: Tangata whenua worldviews, values and wairuatanga are present in the work done.

This provides an integration strategy for all core services. While led by Ministry of Business, Innovation and Employment Hīkina Whakatutuki, this needs to be reflected in good practice-based processes

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[13] *"New Zealanders expect government and all its agencies to exercise power legitimately: upholding democracy and human rights, respecting the law and Te Tiriti o Waitangi/the Treaty of Waitangi (Te Tiriti), and contributing to an inclusive, cohesive society."* - Te Kawa Mataaho Public Service Commission. https://www.publicservice.govt.nz/resources/strategic-intentions-2021-25/?e6747=6751-introduction

adopted across all organisations in the RSI system, inclusive of end-user government departments, CRIs, tertiary providers, IROs, industry etc.

Q5 Te whakamana me te whakahaumaru i te mātauranga Māori Mātauranga Māori? - What are your thoughts on how to enable and protect mātauranga Māori in the research system?

Royal Society Te Apārangi acknowledges and highly values mātauranga Māori. It is a priority of the Society to protect and defend the indigenous knowledge system distinct to Aotearoa – he taonga Māori, he taonga tuku iho.

Heoi anō this needs to be guided through wānanga and by a robust co-design process enabling exploration of kaupapa ideas and development. Hīkina Whakatutuki has a responsibly to raise the public visibility, importance, value, status and opportunity for mātauranga Māori and kaupapa Māori research. Hīkina Whakatutuki will enable this through creating, building and strengthening authentic relationships with Māori researchers, iwi and hapū.

A greater pool of specific funding for mātauranga Māori, integrating the presence of experts into governance across the entire RSI sector, and increasing funding and support for community-led research are options; a wānanga and robust co-design process will ascertain whether these and/or other initiatives are what is desired.

Institutions, especially CRIs as inter-generational stewards of much of the country's knowledge and research infrastructure, play a vital role in building the necessary long-term relationships to support these aspirations. These institutions must recognise their role in this and be actively encouraged and supported in achieving it. The over-reliance on a short-term highly competitive research funding system over many years is likely to have restricted long-term relationship development with Māori and other communities.

Q6 Te whakapakari hononga ki te mātauranga Māori ā-rohe Regionally based Māori knowledge hubs - What are your thoughts on regionally based Māori knowledge hubs?

It is pleasing to see a shift to an at-place model defined by kaupapa Māori and mātauranga of iwi or rohe. Significant investment and commitment is required now and to be continued for this kaupapa (funding, capacity building, leadership, systems, infrastructure etc).

This again needs to be guided through wānanga and by a robust co-design process enabling exploration of kaupapa ideas and development. The Society is supportive of kaupapa Māori ā-rohe if this created a system that was more responsive to Māori priorities.

Hīkina Whakatutuki should develop localised Māori engagement and access plans, creating a Māori Partnership model through regional wānanga. A focus must also be on building local connections, capacity, tikanga, kawa and hapori grounded in trust and respect. Through wānanga, Māori within the RSI system and Māori communities can also identify what connections, structure and processes within and between parts of the system could help sustain and amplify mātauranga Māori.

Kaupapa Tuatoru Te Tuku Pūtea
Theme 3 Funding

The Society strongly encourages MBIE to consider any changes to the RSI system with a long-term perspective.

The primary way the government directs and influences the entire RSI system is through funding research. The funding system reform aims to give effect to national research priorities (determined as part of this process) that are whole-of-system in practice and to also ensure research institutions are equipped to deliver on these priorities.

Research, science and innovation are long-term endeavours that necessarily outlast particular governments. Various reforms to the RSI system over the years have sought to address the same or similar issues outlined in Te Ara Paerangi. However, it is not helpful to the long-term interests of the system, or for the certainty of people and organisations working within it, if strategies are revised or redone too often. For changes to the funding system and organisation of institutions and infrastructure to be successful there must be continuity and certainty for the foreseeable future and beyond.

These aspirations need to be balanced with sufficient flexibility in the system to address emerging issues and to capitalise on new opportunities that arise serendipitously, as well as to quickly respond to global crises as seen with the COVID-19 pandemic. Striking the right balance of ensuring stability in the system through a long-term lens, along with the flexibility to respond to change, is necessary for an effective outcomes and impact-focused RSI system.

Researchers also need to be able to maintain their freedom to investigate opportunities that do not align with existing priorities and that in turn may lead to transformative research and innovation, and to do so in a way whereby competition doesn't continue to dampen down the full potential of the research that could be initiated. To do this requires retention of those existing funding schemes, albeit with any necessary refresh, that foster a researcher-led approach.

We respond here to the following questions:

Q7. Ngā kōwhiringa matua mō ngā taumahi matua
Core functions - How should we decide what constitutes a core function and how do we fund them?

Use of dedicated ring-fenced funding – the Society strongly supports the intention to provide dedicated funding to critical research functions.

This includes, for example, research into infectious disease and cybersecurity threats, high priority services, emergency response, and databases and collections. Innovation invariably extends, builds on

and uses existing knowledge. While one intended outcome of an RSI investment should be at the frontier, a significant portion of the investment over time may go to maintaining or adding to necessary databases and collections, maintaining high-end computing and storing of research data and managing its quality, making it accessible and building and maintaining relationships (connections) that may be helpful in future projects. Trade-offs should not be needed (as they currently are and historically have been) between these core functions versus other priorities.

Databases and collections

Biological collections, taxonomic research, and the associated databases and biodiversity information systems provide the scientific baseline for New Zealand's unique biodiversity of both native and introduced species.

For example, New Zealand's national taxonomic collections (which are distinct to New Zealand) and taxonomic expertise are vital to our economy and society. New Zealand is a recognised biodiversity hotspot with rich, diverse and unique biological ecosystems and, as such, is of supreme interest and importance from a global perspective. New Zealand should strive to have deep and comprehensive knowledge of its biota across its lands, fresh waters, and surrounding seas. However, taxonomic understanding of the New Zealand biota is undeveloped compared to other advanced economies, and we know far less about our marine areas than we do our land.

These databases provide immense value across science and society, including biosecurity, food production, trade, medicine and public health, conservation, ecology and environmental science. They ensure ecological science is reproducible, and allow New Zealand to sustainably manage and protect its natural resources and economic opportunities. They enhance New Zealanders' health and wellbeing and enable New Zealand to meet its moral and legislative and international obligations [20] [21], along with helping define New Zealand's evolution, our nation's uniqueness and our cultural icons. We support maintenance of databases and collections as of pivotal importance in providing us with the ability to have a long-term perspective to both look forward and look back.

Data storage

A national framework and approach to data would be highly beneficial.

Within this context, there needs to be careful thought give to data storage and its resourcing to ensure we don't lose critical digital and non-digital data. Data and information acquired through Crown funding should be made publicly available unless there is a good reason otherwise (e.g., national security, personal privacy, iwi/hapū-owned data) and in general there should be a strong push across the sector for open access data.

It is critical within such a process that a te ao Māori lens is applied to consider data sovereignty, including advocacy of Māori rights and interests in relation to Māori data, and appropriate data governance that safeguards and protects data for and about Māori, including data for taonga species, that may in cases be iwi- or hapū-specific taonga [22]. While potentially led by MBIE, this needs to be reflected in good-practice processes adopted across all organisations in the RSI system, inclusive of end-user government departments, CRIs, tertiary providers, IROs, industry, etc [23].

Critical emergency response

Investing in high-priority areas and emergency response are also critical functions.

We need to ensure we maintain a readiness to respond to emergencies, given that we live in a rapidly changing world, where impacts of pandemics such as COVID-19 are related to and exacerbated by climate change, for example.

General comments

Best outcomes will be achieved when a mix of stakeholders is involved in decision-making, including key end-users such as functional government departments (e.g. MPI, DOC, MfE etc) and researchers, rather than the funder (MBIE) solely.

Determining what constitutes a core function requires a carefully conducted process to avoid research organisations with limited resources needing to balance research services against each other, with sometimes detrimental impact on critical research functions. Getting this right is important as commercialisation increases when we do. Moreover, lessening the impacts on outcomes on any trade-offs made between different core functions is important. Researchers could make a case for what is core function, for example, through assemblage of expert panels, and have representatives on resourcing decision panels also. A reasonable level of autonomy within research organisations needs to be enabled.

The Society generally agrees with the propositions 1-3 for core functions provided in the discussion document at the Te Ara Paerangi Funding March 2022 workshop. In particular, core functions should be available where long-term secure funding is needed to support activities that underpin a wide range of research projects/outputs/investments.

Regarding proposition 4, "funding investigator-led research and associated services as 'core functions'", this is to some degree already the case through the Government's Strategic Science Investment Fund. The important thing is to ensure continued capability in priority areas so that research priority can pivot as necessary in times of need.

There are several principles or characteristics that could be used to select core functions through a process of questioning: long-term need, accessibility and open licence principles, collections and databases (linked to the first two principles), emergency and hazards; what human capability is developed and needed; and is this something that may not have an identifiable research "impact" pathway at the outset? Together, these encapsulate most of the three categories (critical research, high-priority services, databases, collections and monitoring) proposed in Te Ara Paerangi. Also important is considering how the capability of workforce ties in with core functions.

Q8. Ngā kōwhiringa hoahoa mō tētahi tauira tuku pūtea hou Establishing base grant and base grant design - Do you think a base grant funding model will improve stability and resilience for research

organisations, and how should we go about designing and implementing such a funding model?

The research funding regime should provide a level playing field whilst recognising that different organisations play different roles in the system.

For example, TEOs and CRIs are not set up to be functionally the same. We need to fund the things that we as a nation view as important and provide greater stability for organisations, with a focus more on collaborative and transdisciplinary effort than unproductive and restrictive competition, so that we gain greater efficiencies within our RSI system. This should also be inclusive of community-connected research. The competitive constraints that exist currently in the system negatively impact on it, including reduced outcomes from the CRIs working predominantly in isolation and continually fighting for funding to maintain their existence.

We agree that for much research a good approach is priority setting → funding of priority → link to research strategy. Creating a national research system, with a move away from silos, is likely to be beneficial, and we strongly support creating systems that improve connectivity, especially between CRIs, universities and wānanga, and increasing strategic funding for industry-targeted research.

We strongly support a greater focus on fostering international connectivity as this will also strengthen our RSI system overall.

A useful starting point is MBIE's observation that overseas generating new knowledge overseas tends to be housed deliberately in research organisations whereas service or monitoring functions tend to reside in service agencies or government departments. It is also important to recognise that service or monitoring activities sometimes stand isolated from rather than fully integrated across the system.

A base grant model would offer harmonisation with international systems, making it easier for researchers to participate in international programmes. This is important as we cannot generate all the new knowledge we need within New Zealand. Linkages with the international science community stimulate new ideas and developments; moreover, New Zealanders can bring a unique perspective to international science programmes. The return usually far exceeds the investment because of synergies combined resources can bring to multidisciplinary projects.

If a base grant funding system is employed to improve stability and resilience for research organisations, we would support a combined funding system for varying the level of base grant over time.

A combine funding system could incorporate a performance-based approach that factors in differing research costs in different fields, along with an activity-based system and a negotiated system. We are concerned, however, that substantive changes are likely to be very costly and that the benefits must significantly outweigh the cost to change the model. In addition, it is not clear at present what kind of base grant mechanism is envisaged – is this a base grant for individuals or for organisations, for example?

A single base grant funding approach can make it more difficult to establish new research activities – a combined approach allows for start-ups and new research groups to form naturally. We are mindful

too that even with a base grant system in some form, a competition of ideas will remain. Competition cannot be entirely removed from the system and does indeed offer some benefits. A further caveat in any such system is around barriers to entry, including skillset, and the transparency that would be required. It would be advantageous to look at the existing collaborative funding models we have and ascertain what works well.

Broader funding considerations

A balanced investment portfolio is needed. We need a broader strategic approach to RSI investment in New Zealand. A mix of different funding types is required, with a balance between the creation of new knowledge and the extension, maintenance, use and deployment of existing knowledge to meet our future national needs (e.g., from Marsden to Endeavour to SSIF and beyond to even more targeted strategic funding).

The Society's broader view of the funding model is that innovation both at the frontier (creating new knowledge) and behind the frontier (using existing knowledge to improve the ways we do things) are important as innovation invariably builds on and uses existing knowledge.

At a strategic or organisational level, our historical reliance on competition to drive excellence creates a tension with cooperation between entities. Funding allocation will always be contentious.

In addition, individual fellowships in research areas of current strategic importance as well as investigator-led programmes will help to secure broader capabilities that can support current and future national needs. It would be helpful to better understand how other countries have found an appropriate balance between the benefits of competition for funding, whilst allowing the flexibility needed to enable enduring connections to develop and bear fruit.

Excellence and impact

How we value and measure excellence and impact across these different funding types is important and indeed may also differ across priorities.

There are changing conceptions of research excellence emerging in an engaged, interdisciplinary, and cross-sectoral world.

For example, the key driver for research in the Marsden and the Endeavour Fund is researcher-driven curiosity exploring questions not yet answered. Such excellent and non-targeted research will be at the knowledge frontier, and an academic view of excellence is appropriate, with assessment of impact and connections of lesser importance. In contrast, the potential for impact and uptake by end-users is vital for research into serious environmental issues or to map biodiversity, and a suitable test of excellence may include "fitness for purpose" for achieving impact and uptake. Such research might be less at the knowledge frontier, whilst still providing new knowledge or adding to existing knowledge, but it could well have much greater potential for human and intellectual capital formation than an alternative proposal that looks academically more eloquent. It also requires investment in the infrastructure to support it.

This changing perspective on excellence and impact has implications for our funding arrangements. We know from Māori researchers and community organisations the importance of research partners being named as full co-investigators rather than simply as sub-contractors. Indigenous peoples want to have control over research processes and to achieve reciprocity, another Te Tiriti o Waitangi principle, within research relationships.

This aligns well with a co-design and co-creation model, where such partners can be brought in at the beginning of the research process, or where they lead the research and are recognised as full contributors to the research process. To deliver more fully on these ambitions for collaborative research, there may need to be increased use of two-stage funding models that allow for the explicit funding of relationship building; and for partnerships in which non-traditional research organisations have control over their own proportion of the funding [24]. This will help improve responsiveness to Māori.

Overall, there needs to be much greater focus and funding directed towards community-led research and engagement.

Kaupapa Tuawhā Ngā Hinonga
Theme 4 Institutions

The theme that drives our submission is the importance of the totality of the RSI sector and the organisations within it when considering what to change and how to change, including contextualising our institutions as part of a global RSI system.

We have connectivity to all those parts like a subway network, and that connectivity needs to be built on and improved, inclusive of property, infrastructure, workforce, and research activities. Making changes to the system that foster connectivity and collaboration will be greatly advantageous, given present and future challenges and opportunities, especially among CRIs, universities and wānanga, and between those entities and industry and end-users.

The Society is not well positioned to comment on the policy settings on CRIs. However, we note that CRIs represent one form of priorities in the system in that they have specific purposes and missions agreed by government.

We agree that CRIs optimising from a national perspective is not the same as optimising from an organisational perspective and that this has led in part to substantive portions of their work being focussed away from public good applications. Notwithstanding, some of the CRIs have been successful in earning significant non-government income that has allowed them to enhance their capability and services in relevant areas.

The Society supports looking more deeply at the role of CRIs, particularly to understand their individual characteristics and the specific opportunities they can offer in the future RSI system. In doing this, the government needs to be mindful that these institutions employ a significant number of researchers and are stewards of critical parts of our research infrastructure and that major change could bring significant disruption. We answer the following two questions together here.

Q10. Te whakawhanaketanga me te tautiaki pai ake o te hunga mahi me te raukaha
Role of institutions in workforce development - How can institutions be designed to better support capability, skills and workforce development?

Q11. Te ruruku pakari ake me te arotautanga o ngā haupū rawa me ngā rawa nūnui
Better coordinated property and capital investment - How should we

make decisions on large property and capital investments under a more coordinated approach?

As more research takes place in universities and other TEOs and IROs than it does within the CRIs, it is important to understand the balance of where research takes place presently, along with considerations of how that may or may not change in the future. This is especially so when thinking about resourcing and designing institutions and workers within them, along with the funding scenario across the New Zealand RSI system.

While there is the desire for greater connectivity and collaboration across organisations, there is also a need for awareness of who does what and defining institutional roles and allocating funding. Factored into the system are tensions to resolve in where adjustment needs to occur and where funding is directed.

Connectivity and collaboration

Fostering greater institutional connectivity is pivotal – both nationally, with industry, and internationally.

Universities are predominantly, but not exclusively, the breeding ground for new researchers; thus, fostering greater connectivity between CRIs, universities and wānanga needs prioritisation to create awareness of a variety of career pathways within and around the RSI system.

Although this might be seen primarily as a workforce concern, evaluating property and capital investments and enhancing their integration and coordination across institutions will also support greater collaboration and connectivity. Doing so in such a way to leave space for agility around future foci will be challenging, but not impossible. International examples demonstrate core platforms/virtual institutes/shared facilities play a crucial role in advancing high-impact research discoveries [25].

A variety of levers exist for fostering greater transdisciplinary activity: e.g., shared facilities (property), infrastructure (research equipment), funded core platforms, additional funding that supports collaboration and career pathway flow including the technical workforce, priorities that emphasise collaboration, funding to support training in new technologies or shared equipment, co-governance. Use of such levers, especially among reconfigured CRIs, universities and wānanga, should create better value from our research dollar. Virtual research institutes can be highly successful endeavours, as our CoREs demonstrate.

In addition, deliberately fostering working relationships between our research organisations and industry, the innovation sector and functional government departments will also create greater impact from our RSI system. Examples include: shared facilities, industry- or innovation-supported spaces within our research institutions, co-funding by industry and innovation entities, additional funding that supports collaboration with these entities, engagement strategies that support relationship building and ideation, and funding for secondment and intern opportunities.

Value needs to be placed on our linkages with international institutions and ensuring that funding is directed to grow and maintain these, including support for researcher access to the synchrotron, to CERN etc, as well as exploring new linkages.

Whakawhanaungatanga Relationship building

Perhaps the answers are strikingly simple? The commonality across every aspect of the RSI system, despite the diversity of organisations where research occurs, is people. He tangata, he tangata, he tangata.

It is in whakawhanaungatanga, the fostering and building of long-term relationships and partnerships, that we can better support capability, skills and workforce development, address inequities and their drivers, and achieve greater research impact. This includes between and among CRIs, universities and wānanga, and with those and industry, with Māori, with Pacific peoples, with innovation entities such as frontier firms, and with other end users.

The levels at which this relationship building can occur are varied, and Figure 3 in Te Ara Paerangi shows some of the mechanisms. We believe that the concept of relationship building should be put at the heart of design in some of the levers listed above, and funding mechanisms should be explicitly used to support this and should also come from a Te Tiriti-led approach.

Skill and capability building

Skill, capacity, and capability building to develop the workforce, including growth of the Māori and Pacific academic and professional staff workforce, should be integrated into all organisations in the RSI system and directly supported.

Although universities and wānanga may play the most pivotal role in this by training many of our future researchers, all organisations have a responsibility to engage in this space. We need to operate differently to create the capability and the workforce we need – now and tomorrow. Certainly, it would be useful if organisations were incentivised to develop key capabilities and literacies for the RSI system in their workers and in their students. We explain what we believe these capabilities need to be more fully in our response to Theme 5.

Incentives are needed to support training systems to develop these various capabilities within organisations for all staff, or across organisations. Then funding opportunities for organisations to embed the desired capabilities and skills through practical application will appropriately reposition our RSI workforce. This will make the RSI sector a more attractive employment proposition. We have listed some of the potential levers above. Additionally, a strong focus on secondment and intern opportunities, where students or workers from one organisation can gain experience in another, should lead to a lift in capability across the system. In turn, this will further support movement of researchers around the system and more flexible career pathways, as more people will have the capabilities required to work in multiple organisations during their career, should they desire.

We also greatly support reconfiguration of the system through these mechanisms and levers to reduce institutional racism. This needs to be done in complete partnership with Māori and with Pacific

peoples, with all changes made with consideration of te ao Māori and a Te Tiriti-informed approach throughout [26] [27]. This includes increased support for adopting and valuing Māori and Pacific research methodologies and approaches.

Property and capital investments

In terms of a more coordinated approach to large property and capital investments, it would be helpful for a full stocktake (Q11) to be done across the RSI sector, coordinated by MBIE.

We support involving researchers and organisational leadership (from across the sector) and key end-users in a second phase of this process where current and future needs around these areas are examined. Both top-down (system level) and bottom-up (institutional and researcher level) priority setting and horizon scanning could inform subsequent funding processes, including any decisions around co-location.

This could be repeated periodically to ensure continued examination of future needs and their refinement. Institutions should be able to make a case for what's important for them and to be able to contextualise that within what's important for New Zealand. There should also be opportunities within the funding landscape for institutions to have autonomy over some aspects of property and capital investment.

Q13. Ngā pāpātanga pai ake – te whakawhiti mōhiohio me ngā pāpātanga rangahau
Knowledge exchange – How do we better support knowledge exchange and impact generation? What should be the role of research institutions in transferring knowledge into operational environments and technologies?

Aotearoa New Zealand needs to lift its impact from research through greater knowledge exchange and greater translation into both commercial and non-commercial 'public good' use, as historically this has been an area that we have not realised potential as well as we could.

As in our comments above, a strong emphasis on relationships and their fostering, especially with present and potential future end-users, including functional government departments, will be one of the most important steps in achieving this.

The role of engagement, community, schools, kura and co-design

Engagement is essential for improved knowledge exchange and relationship building. Providing much greater scope and funding for engagement, especially community co-design, is a pivotal part of the research process and beyond.

This includes science communication but goes much further than that. The goal of A Nation of Curious Minds is to "encourage and enable better engagement with science and technology in all sectors of New Zealand" [28]. Community co-design, including with schools and kura, and citizen science need special mention here.

This kind of engagement is often viewed as an addendum and "nice-to-have". Little recognition is given to how transformational such an approach is. If we invested adequately in this space, we would create a society that is more engaged with research, science and technology. Benefits would include a workforce more responsive to societal needs, to working collaboratively, to communicating well and to having deep relationships with end-users, to name but a few [29]. This approach is well suited to incorporating te ao Māori.

Community co-design is also a means of gathering new knowledge as well as sharing it, of finding new ways to approach questions and issues and opportunities, and of considering ideas that are meaningful to a particular community and that have their buy-in. It can be a means of developing new opportunities for new innovative enterprises. Funding mechanisms and priority setting can both explicitly support this, and institutions need to be encouraged and supported to make this part of their core activities – not as a recruitment exercise for TEOs, but for TEOs, CRIs, IROs etc to create greater impact and increased integration of the RSI system with society.

Schools and kura have a pivotal role in training the future workforce, including normalising this co-design and community-involved process as one standard way of doing research. We would suggest that MBIE considers that co-creation of human capital and research through education and training can happen much earlier than within a TEO. We need to think more broadly too about what an end-user is – end-users are also our communities. The more community involvement the better; repeated contact is important.

Integral to this and more generally to non-commercial public good use (and building on our data management commentary in our Theme 3 response) is having robust policies around open data, open access and public good distribution of research findings.

Institutional culture, design and relationship building

Institutions, especially TEOs, often don't value, reward, or sufficiently support or train researchers in several key areas of research-related work. These include fostering their relationship with end-users; assisting with opportunities for commercial and non-commercial use; and engagement (e.g., science communication, community co-design,

outreach, consulting service, training). This in turn sends a message to researchers that these are less important aspects of their work.

Embedding these aspects of research into institutional strategy is important – and to do so in a way that does not compromise blue skies research, or public good use. Wānanga can offer institution management, researchers, and end-users opportunities to define the ideal role for a research institution and for asking how to shape incentives so that researchers align (some of) their research with end-users and how these entities want to be engaged.

For enhanced industry connectivity, design of institutions as covered above will assist, as will fostering and rewarding relationship development. In considering the most effective ways of pairing scientific expertise with commercial expertise, asking commercial end-users would be beneficial, and looking at ways in which institutions or, more broadly, incubator scenarios aid this process.

A good, serendipitous example of this is Callaghan Innovation after the Christchurch earthquakes. With surplus space in their Christchurch building, they opened it up to CBD tech companies (especially game development companies) needing office space. The co-location led to many collaborations between Callaghan and the companies and amongst themselves, resulting in the EPIC Innovation building in the CBD [30] still running to this day.

Deliberative efforts to create such innovation hubs may not always be successful; it may be more a case of looking at how the RSI environment can be primed to allow this growth when necessary or advantageous – the deep ecosystems of capability to support future frontier firms referred to in Te Ara Paerangi. Some of the people involved in EPIC are now leaders in the emerging Aerospace sector in Christchurch. EPIC is also a good example of a nonlinear model of innovation, with a complex interactive web emerging, giving rise to repeated collaborations and new technologies.

An emerging approach to innovation is based in te ao Māori, led by Māori. Enabling Pacific-led solutions for Pacific communities is also an effective approach. Looking at ways to potentialize this across the RSI system is important at an institutional and system level.

The role of government departments

We support diversification to consider government procurement as part of the commercialisation ecosystem.

Functional government departments are important end-users. In terms of thinking about different models though, a clear separation of the government department from business/industry would be required. To improve links to research and formation of policy, university papers, microcredentials, internships and secondments would support this as the RSI workforce would be more policy and exchange literate.

Commercialisation

Research institutions, alongside end-users and firms, have a role to play in supporting and establishing the technologies and industries of a future New Zealand.

The Human Interface Technology Laboratory at University of Canterbury is a good example of this. Processes and structures that could establish clear and appropriate roles for institutions, end-users, and firms in knowledge exchange include workshops, guidelines, and suggested pathway documents.

Finally, we need to have an international lens on future commercialisation activities. Rocket Lab and other firms, particularly those in the aerospace and agricultural sectors, demonstrate well the global potential of our commercialisation. Many of these have started outside the RSI system, rather than within it. We suggest looking at whether there are barriers in the system that have led to this and whether changes can be made to facilitate frontier firms developing linked to the system more directly.

Kaupapa Tuarima Te Hunga Mahi Rangahau
Theme 5 Research Workforce

A central theme throughout our submission is the need for enhanced relationships within the RSI system, a need for a greater focus on the people within it and developing their capabilities for the role they play in contributing to priorities for New Zealand as a whole, now and into the future.

Q14 Ngā whakaarotau me te hunga mahi rangahau
Workforce and research Priorities – How should we include workforce considerations in the design of national research Priorities?

Developing capability and capacity effectively within our workforce means there should be no need to balance funding mechanisms for workforce outcomes with other funding like the national research priorities. The two should be integrated and are not mutually exclusive.

Te Ara Paerangi asks important questions about how best to develop and retain talent within our workforce. It characterises a well-functioning system as offering sufficient mechanisms to support career progression, such as appropriate development and leadership opportunities, with progression achievable within a reasonable timeframe, and a significant decline in fixed-term contracts following movement out of postdoctoral roles. If we simply look at the traditional linear model of fixed-term postdoctoral roles through to permanent senior positions, the current system is characterised by a significantly increasing level of precarity and does not meet the characteristics required.

The priority design process for the system should include the questions: "Why do we have an RSI system in Aotearoa New Zealand?", "What purpose does it serve?", and following on from that "Who do we need working in this system to enable our national priorities?" Ensuring we consider the workforce and people (human capital) throughout will lead to better outcomes to facilitate transfer and absorption of new global knowledge for use in New Zealand.

This would include how we design for better inclusivity, especially through the system's capacity for attracting and retaining Māori and Pacific peoples and valuing them as leaders, and for fostering collaboration here and internationally. Some of this design could arise from a detailed examination of the barriers that exist, and by addressing the current inequities.

Q15 He aha te pāpātanga o tētahi tahua tūāpapa ki te hunga mahi rangahau?

Base grant and workforce - What impact would a base grant have on the research workforce?

Depending on the design, a base grant may well improve workforce conditions. However, an important question to ask is "If we move from a base grant model, what do we lose?"

In terms of performance expectations, typically these already exist within organisations, including PBRF in TEOs and other performance indicator systems in CRIs. Adding another layer of administration may not be beneficial. Understanding too the important role international expertise plays and how this might be incorporated into such a system needs consideration.

Q16. Ngā tikanga tuku pūtea hou
Better designed funding mechanisms - How do we design new funding mechanisms that strongly focus on workforce outcomes?

Mobility mechanisms

We are greatly in favour of specific mechanisms, including incentivising mechanisms, that enable researchers to move between different types of organisations, from academia to industry to government. These include short-term secondments, internships at a variety of levels from undergraduate to postgraduate and beyond, joint appointments, or longer-term shifts such as change of role, and all without penalty.

The RSI system has multiple facets that expand well beyond the linear academic model and provide spaces for those emerging through the research workforce and from other sources.

Mobility mechanisms (whether through funding or other levers) within TEOs, CRIs and other organisations or by co-location with stakeholders etc would be valuable additions. Through these we can create an upskilled workforce suitable for future research needs, with a mixture of talented specialists and those able to navigate complex, multidisciplinary, multi-organisation areas, especially the creation of research leaders in the latter. Mobility can also be virtual.

A new model for the RSI system

We propose a move away from a pipeline model, and instead consider one that is more like a subway network, with multiple starting points, the ability to change lines in multiple places etc.

There are many benefits of mobility, including learning new organisational culture, skills and capability, building knowledge exchange and increasing impact and diversity.

Training for skills and capabilities required

The Society's concern is that institutional drivers and a strong inbuilt push for status quo in the system are creating a mismatch between the knowledge and skills acquired through postgraduate tertiary education in this country and the skills needed in employment.

This is in response to Te Ara Paerangi asking how MBIE can engage with the TEO sector to identify how they can better support the training pipeline for different types of RSI careers. The technical aptitude in job applicants appears to be lacking, especially in transferable practical skills that employers are looking for [31] [32].

We know too that Early Career Researchers (ECRs) would like to see TEOs ensuring postgraduate programmes include training and opportunities for relationship building that reflect the full diversity of career pathways that are open to ECRs, including exposure to private, CRI and NGO spaces. This suggests the need for change in doctorates and masters towards programmes where the research is conducted more often in end-user communities through partnerships, with the likelihood the researcher will immediately flow on into worthwhile and stimulating employment there. We need top talent as much in the end-user communities as the research laboratories and this also improves connectivity.

Redefining excellence and impact

A more holistic adoption of research excellence requires different skillsets to those we have traditionally preferred, and when considering research excellence for teams.

As outlined in Funding, there are changing conceptions of research excellence and impact measurement emerging in an engaged, interdisciplinary, and cross-sectoral world. One measure could be Equity, Diversity and Inclusion (see section below). Established relationships, interpersonal skills, and significant amounts of emotional labour are used to negotiate, not just with research partners, but with the rapidly changing expectations of funders and host organisations who now see research collaboration as a means of delivering on wider ambitions. If we need researchers capable of doing this kind of work then, again, we will need to think differently about doctoral training, appointments processes, and academic professional development.

Impact assessment needs to be weighted more, and to be broad-brush, not at a project or even programme level, but at an agglomerated level, and needs to consider community engagement more.

Capabilities and skills

There is a considerable list of additional capability and skills that need to be acquired and developed for current and future needs.

These include te ao Māori literacy, cultural literacy (all cultures, including Pacific peoples), Te Tiriti literacy, research literacy, community and societal literacy, technological literacy, digital literacy, open

science awareness, data fluency and transdisciplinary literacy (noting that not all in the system need to have the latter).

Additional key "softer" capabilities that we need for the present and future workforce include: an adaptive mindset, collaboration, problem solving, self-management, awareness of misinformation and misuse of information and technologies, ethics and risk management.

The role of non-TEO institutions

Mechanisms that support capability training need to be implemented within non-TEO institutions and across institutions, including in the redesign of the CRIs.

TEOs are unlikely to be either adequate or the only settings within which we can teach and train these capabilities across the RSI workforce. As we are an international job market, we cannot expect all employees to come with knowledge of te ao Māori and tikanga etc. For many, this must be learnt from within our institutions. There are also other topics that may not be covered at TEOs and may not need to be – especially if we move as proposed to consolidating governance and organisational functions across our institutions. One mechanism could be an annual cross-organisational programme for new or existing employees.

The role of schools and kura

We believe a key focus needs to be on much earlier seeding of capabilities training, with initiatives that could also involve the Ministry of Education and activities in schools and kura.

Community-based research and citizen science initiatives, involving young people, schools and kura, expose the younger generation to research approaches and can lead to the specific building of the above capabilities. Examples include projects funded through the Participatory Science Platform and Unlocking Curious Minds funds, and through the Science Teaching Leadership Programme (all part of Curious Minds [28]) and Engineering New Zealand's Wonder Project [33].

Moreover, partnering researchers with community groups, including schools and kura, leads to the researcher expanding their skillset, and their understanding of other knowledge sources etc. Rather than being seen simply as (science) education and engagement opportunities, these programmes are transformational, for all partners involved, training the future workforce, and retraining the current workforce for the capabilities we need now and in the future. Increasing funding in these areas and creating nationwide access to schemes like these would seem both a prudent investment mechanism, as well as an important aspect to include in design of priorities towards the workforce we need.

Equity, Diversity and Inclusion

We cannot simply pump more people into the system to address existing imbalances, without significantly reforming the system for their presence.

From an Equity, Diversity and Inclusion (EDI) perspective (and thinking about a transition from a pipeline model to a subway model), the conditions within the system matter most and it needs to be and feel safe, otherwise the outflow results in status quo [34].

Institutions need to value relationships, including researchers connecting with their own community, along with research impact and equity. The right system environment is especially true for Māori, Pacific peoples, women, LGBTQ+ and other minorities, and transparency and accountability need to be built into mechanisms and processes for their recruitment, retention and promotion, and to address systemic racism and other entrenched biases in and beyond TEOs.

The recent Te Whitinga Fellowships offer a specific example of a funding mechanism that has merit in this regard. They were initiated as a response to increased precarity of ECRs during the COVID-19 pandemic [35]. The selection process was first done with excellence criteria, then a lottery approach with a specific EDI overlay was used to select 30 recipients, resulting in a truly diverse cohort.

Top-down quota-based approaches at governance level can also offer effective levers for changing the system and its diversity balance, e.g., legislation in the Netherlands mandating one-third women on to corporate boards [36].

Mechanisms that encourage mobility are another means to achieve EDI within teams and organisations, but with the awareness of where this disadvantages different groups, e.g., Māori, Pacific or other cultures being away from their communities, and parents having to relocate.

We also need to recognise and address via transparent mechanisms the reality of double labour for Māori and Pacific workforce members and what this currently costs them in time and resources to commit to their own career pathways. This could mean funding mechanisms to support creation of special roles to relieve the cultural burden off individual RSI researchers/technicians, and/or adjusting research excellence and impact approaches.

Precarity in the system

Increasing the number of schemes, such as fellowships, for ECR through to mid-career researchers is in line with many other countries and would produce greater stability.

At present the system is self-perpetuating with funding mechanisms that serve to promote and retain the status quo, resulting in a great deal of precarity.

Specific postdoctoral positions could also be created for research projects that specifically align with work the government is interested in pursuing, providing ECRs with important opportunities to build relationships outside of academia and contribute to policy and change, an important part of a thriving research sector. Having greater representation of ECRs in governance and funding decision-making would also be beneficial.

At the same time, although precarity exists in the system, ECRs need to be made more aware of the breadth of careers and the limitations of retaining a narrow focus on academia or pure research. If the expectations are changed, then the entitlement also changes. Precarity exists in several other sectors, where contract work is also prevalent (e.g., communications). What can we learn from other sectors as to how to address precarity, or where precarity may have a positive place to play?

International considerations

The Society supports the focus on connections that help build and transfer human and intellectual capital within the local and global research and end-user communities.

The goal of developing and retaining talent is worthy. It should also be acknowledged that time spent in international contexts develops connections, aiding knowledge transfer back into the country. It is also important to note the role of specialisation in an increasingly knowledge-led world and our small contribution to the global knowledge base.

The research community is part of an international labour market – for researchers to be attracted and retained, the working conditions and rewards need to be sufficiently attractive. New Zealand's economic geography and location demand greater government support to incentivise connectivity than other similar countries.

The technical workforce

A striking omission throughout Te Ara Paerangi is the remainder of the workforce beyond researchers themselves. The function of the RSI system goes far beyond a narrow focus on research, as development, innovation and engagement are also vital.

There are many other key role types that comprise our RSI system and a major contributor is the technical workforce. Examples of their importance include laboratories focused on environmental or health monitoring and DHB laboratories doing diagnostic testing.

An updated report we published in 2019 examined the future needs of the New Zealand economy for science technicians, what future roles might look like, issues around career structure and enhancing pathways, processes for training and key skills and competencies needed, what a national qualification structure might look like and how it intersects with other qualification systems [31]. The Level 6 Diploma in Applied Science through polytechnics is an underutilised but fit-for-purpose qualification, and, as alluded to above, the transferable practical skills within the Bachelor of Science qualification need to be enhanced to be fit for purpose.

Careers advice given to young people should realistically set out the routes and career opportunities in the technician workforce, like the Engineering Education-to-Employment (E2E) programme operated by the Tertiary Education Commission. Undergraduates experiencing practical internships with interested employers would aid to lessen on-the-job training of new employees. Mechanisms to support this as part of the mobility levers should be considered.

The Society also supports any continued effort to build a strong high-technology sector alongside our existing industries to lift productivity and support our economic aspirations.

Kaupapa Tuaono Te Hanganga Rangahau
Theme 6 Research Infrastructure

Our research infrastructures are a key component of the machinery of our RSI system, and they need greater, more sustainable coordinated investment.

This includes identifying where future-focused investment is required to keep the system running smoothly and at full operating speed. Infrastructure includes both equipment (such as high-speed computer facilities and networks) and the data that provides much of the evidence base for the research system (e.g., understanding our biodiversity).

It also includes many elements of "softer" infrastructure. For example, Aotearoa New Zealand's national taxonomic collections (which are distinct to this country) are vital to our economy and society. Biological collections, taxonomic research, and the associated databases and biodiversity information systems provide the scientific baseline that underpins the management of New Zealand's unique biodiversity and living economic resources, including both native and introduced species. They ensure ecological science is reproducible and enable New Zealand to meet its legislative and international obligations [20].

Q17. Ngā kōwhiringa hoahoa matua mō te tuku pūtea ki te hanganga rangahau
Funding research infrastructure - How do we support sustainable, efficient and enabling investment in research infrastructure?

New Zealand has historically underrated the importance of research infrastructure and this is reflected in an infrastructure deficit, due to the current system's competitive and short-term approaches, rather than its fostering sustainability.

The Society agrees this competitive, short-term status can lead to institutions focusing on their own benefits rather than system benefits, contributing to this infrastructure deficit. The RSI reconfiguration needs to recognise this and propose investment at more realistic rates, as occurs in other countries such as Australia.

There has been long-term underinvestment in monitoring, managing, and protecting the natural capital of our land and marine environments. We agree that research institutions don't all have equity of access and that current costing models are sometimes not good value for money for national research infrastructure.

Infrastructure is justified as an essential enabler, also by the increased efficiency it brings across the system compared to local supply, which may lead to duplication or competition. Infrastructure requires a long-term commitment and stable investment through mission-led-type scenarios, for example, to work effectively. It also requires horizon scanning to be able to maximise the value of future infrastructure, as well as to sustain existing infrastructure, where it is still needed. The annual cost of providing enabling infrastructure is a relatively small fraction of the benefits. For example, an

effective biological collections infrastructure is critical in the defence of the economy, environment and society against pests, diseases, and weeds which currently cost New Zealand $2.45 billion annually, and in ensuring market access for New Zealand's $1.5 billion seafood exports [20].

Infrastructure prioritisation

To decide what infrastructure is or may be important in the future, we need to examine what we are trying to achieve, apply principles to frame this, and then develop a process to decide our national research infrastructure priorities.

Infrastructure could be viewed as a priority for the RSI system, as opposed to a research priority per se, responsive to system needs and linked not only to our priorities for RSI and their research strategies, but also to our overall purpose as a nation. Within that infrastructure priority, there will be specific key sub-priorities that need to be determined through analysis of current needs and capability, along with horizon scanning, also involving key stakeholders (e.g., industry, Māori, Pacific, innovation sector, functional government departments) to identify future needs, including future capability needs.

We need to start by knowing what we have, through a consultative stocktake of what we have nationwide. We need to explicitly fund the things that we as a nation think are important (i.e., overall allocations of funding designed for societal ends), and then at the RSI system level that we consider to be important (e.g., next-tier funding mechanism in action disseminating the overall pool, including targeting to high-priority areas). Institutions also need to retain a good level of autonomy to support their needs and can indeed make some funding decisions themselves.

In other words, there are multiple levels at which priority setting can occur. Government working in partnership with research organisations to determine where the information advantage lies to determine decision-making roles, ownership and governance will result in better outcomes.

A strategic approach

Balance needs to be struck between discretionary and non-discretionary funding for infrastructure and between system-level investment and individual institutional autonomy.

Allocations would include dedicated funding for critical research functions, high-priority services, emergency response and databases and collections. Examples of this would be a much-needed ring-fenced fund for taxonomic collections and databases; dedicated long-term funding to greatly improve our environmental monitoring; and long-term funding to support data management, as this is vital. Analysis should occur as to how these key sub-priorities fit and relate to the whole-of-system priorities.

The stocktake and horizon scanning and priority and then sub-priority setting process could also include strategic assessment of where collaboration is vital or recommended, where co-location is

advantageous for efficiency and where infrastructure connectivity can be enhanced and leveraged, inclusive of international connectivity and collaborations.

Flexibility should be built into the funding mechanism to allow for allocation to emerging system or infrastructure priorities. Consulting a full range of stakeholders in the strategy-setting process and, where appropriate, in the priority and sub-priority setting, along with relevant expertise on funding panels should result in better outcomes.

With respect to government oversight and institutional decision making, all the following factors are important and should be considered: strategic priority, potential value, scale or long-term nature of investment required, nature of use and whether multiple users benefit or are required to achieve value, resilience and sovereignty including data sovereignty (covered earlier in our submission), opportunities to support international cooperation, efficiency.

The questions What infrastructure is required to best support mātauranga Māori? "What existing infrastructure best supports innovation?" and "What future infrastructure may we need to grow our innovative capacity?" need to be considered. Funding mechanisms need to be linked to appropriate governance structures for the different types of infrastructure — we have to ensure better accountability over infrastructure and its maintenance.

This could, for example, look like a potential national level infrastructure fund linked to national priorities versus more localised institutional infrastructure funding. A national infrastructure board that oversees most of these infrastructure activities could be beneficial. Any decisions, though, such as on which model, which mechanisms, which incentives, which processes, ownership and who needs to be involved and at what level, should be derived from wide stakeholder input, inclusive of institutional and researcher representation, industry, Māori, Pacific communities, and relevant government departments.

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