From: no-reply@mbie.govt.nz
Sent: Sunday, 10 November 2019 8:54 p.m.
To: Research, Science and Innovation Strategy Secretariat
Subject: Draft Research, Science and Innovation Strategy submission
Attachments: Online-submission-form-uploadsdraft-research-science-and-innovation-strategy-submissionsMBIE-submission-form-research-science-and-innovation-strategynotes-during-boardmeeting-20191110.docx

Submission on Draft Research, Science and Innovation Strategy recevied:

Are you making your submission as an individual, or on behalf of an organisation?

Organisation

Name

Nick Jones

Name of organisation or institutional affiliation

University of Auckland

Role within organisation

Director / CE

Email address (in case we would like to follow up with you further about your submission)

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Which of the below areas do you feel represents your perspective as a submitter? (Please select all that apply)
If you selected other, please specify here:
Gender
Ethnicity
Name of organisation on whose behalf you are submitting, if different to the organisation named above

New Zealand eScience Infrastructure - NeSI

In which sector does your organisation operate: (Please select all that apply)

Research , Industry, Government

If you selected other, please specify here:
How large is your organisation (in number of full-time-equivalent employees)?

35

Please indicate if you would like some or all of the information you provide in your submission kept in confidence, and if so which information.

None

Please upload your submission document here

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MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Research, Science and Innovation Strategy

Submission form

The Government is developing a Research, Science and Innovation (RSI) Strategy to set out our vision for RSI in New Zealand and its role in delivering a productive, sustainable, and inclusive future.

We are keen to hear the views of New Zealanders on the draft Strategy so that we can get a better understanding of what our country needs from RSI. We also are looking for feedback on how we can take action to ensure New Zealand's RSI system is optimised for success. These views will inform the direction of Government investment in RSI and the research and innovation areas for us to focus on as a country, as well as help us understand the challenges we need to overcome.

We encourage anyone with an interest to make a written submission.

How to have a say

We have included a number of questions in the draft RSI Strategy document to highlight issues on which we would like further input. We encourage you to use these questions as a guide when submitting your feedback.

This document provides a template for you to provide your answers. Please upload the completed document using our online submission page.

You do not have to fill out every section – we welcome submissions on some or all of the questions.

The closing date for submissions is 10 November 2019.

After the consultation period finishes, we will analyse the submissions received and incorporate the feedback in the final version of the strategy.

Confidentiality

Please note: All information you provide to MBIE in your submission could be subject to release under the Official Information Act. This includes personal details such as your name or email address, as well as your responses to the questions. MBIE generally releases the information it holds from consultation when requested, and will sometimes publish it by making it available on the MBIE website.

If you do not want some or all the information you provide as part of this consultation to be made public, please let us know when you upload your submission. This does not guarantee that we will not release this information as we may be required to by law. It does mean that we will contact you if we are considering releasing information that you have asked that we keep in confidence, and we will take your reasons for seeking confidentiality into account when making a decision on whether to release it.

If you do not specify that you would prefer that information you provide is kept in confidence, your submission will be made public. While we will do our best to let you know that we plan to publish your submission before we do so, we cannot guarantee that we will be able to do this.

Contribution of Research, Science and Innovation

This strategy is about New Zealand's Research, Science and Innovation (RSI) at a high-level. Its aim is to identify challenges and opportunities that will have the broadest impact on our research and innovation activities. For this reason, it mentions few specific areas or sectors of research and innovation. For this draft version of the Strategy, we are keen to hear from researchers, innovators, businesses, and providers of public services on what the RSI system could be doing to accelerate progress on Government's priorities.

Question 1: Where can the RSI system make the greatest contribution towards the transition to a clean, green, carbon-neutral New Zealand?

Question 2: Where else do you see it making a major contribution?

Question 3: What else could else the RSI system be doing to accelerate the progress towards the Government's priorities*?

* see list of the Government's twelve priorities included in Part 1 of the draft Strategy.

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Globally, the methods and practices of science are rapidly evolving. Rich datasets, sophisticated models, and ceaselessly increasing computing power underpin science's ability to understand phenomena and discover new knowledge.

In the context of our transition to a clean, green, carbon-neutral New Zealand, research use of modelling and simulation often allows us to reduce the amount of experimental work needed, thereby reducing waste in the pursuit of dead ends.

With the Digital Age is upon us we now need to embrace what this means for our science system. We recognize a highly skilled workforce is an area where New Zealand performs in the bottom 20-40% (2019 Skills Strategy) of OECD nations. And we're often a late and conservative investor in the advanced technologies, skills, and infrastructures which might propel our science forward. Our full cost funding of research and co-funding for research infrastructure creates conservative cultures within small scale communities working in sometimes quite complicated investment structures. These conditions make it challenging for researchers and institutions to be generous, adopt risk, and drive towards optimal national outcomes.

MBIE as sector steward has a unique role in developing public and private sector digital and computational research capabilities and researcher skills to ensure we remain competitive in this new era. Lifting sector productivity and achieving the Governments stated 2027 goals needs commitment to a coordinated plan of actions to transform our RSI system into a digitally literate, data intensive and computationally skilled powerhouse.

MBIE should show leadership, driving our RSI system in adopting advanced technologies and supporting science sector digital transformation.

Researching and innovating towards the frontier

Question 4:	Do you agree that the RSI Strategy should be focused on innovation at the "frontier" (creating new knowledge) rather than behind the frontier (using existing knowledge to improve the ways we do things)?
Question 5:	In which research and innovation areas does New Zealand have an ability to solve problems that nobody else in the world has solved? Why?
Question 6:	In which areas does New Zealand have a unique opportunity to become a world leader? Why?
Question 7:	What do you consider to be the unique opportunities or advantages available to the RSI system in New Zealand?
Question 8:	What RSI challenges are unique to New Zealand, that New Zealand is the only country likely to address?
Question 9:	What are the challenges of innovating in the public sector? How do they differ from those in the private sector?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

We need a balance of focus behind and at the frontier, though perhaps in a slightly different manner than the strategy currently addresses. To innovate at the frontiers of science often depends on innovation within the practices and systems of science itself – we need to apply innovations to the conduct of science itself, its systems, structures, and practices. Creating new digital methods, instruments, tools, and acquiring and adopting adanced and transformative technologies underpins novel approaches to discovery and lifts productivity in research. These needs sit behind the frontier of science, within its peoples, communities, and institutions.

We have a relatively new and unique eResearch ecosystem – with few organisations, and a short history. We have strong evidence of success from within our initial relatively conservative investments. We have been successful at exploiting our investments, though where we have capabilities we quickly consume their limited capacities. We have few interventions to drive skills and uptake in an inclusive and dispersed manner across communities and geographies, and to drive translation and adoption of advanced technologies into our science system.

Research operating in this ecosystem is already strongly focused on our climate, environment, feed and live stocks, our agricultural system, and other essential contributors to understanding and developing a low carbon economy. It has a growing focus on our people, on research in partnership with te ao Māori, and on innovating in understanding and addressing human health and wellbeing including the unique needs of Māori and Pacific peoples. There are globally recognised strengths in a wide range of natural hazards, including an emerging strength in computational seismology. Differences in data across areas of need and application create a uique profile to our research drivers, and to the eResearch ecosystem we develop to meet these research needs.

We need a more inclusive eResearch ecosystem operating at truly national scale, one which opens opportunities across research communities and institutions. We need a fuller range of services which leverage our current foundations in high performance computing and networking. We need support for contemporary styles of interactive and cloud-like advanced research computing, and we need to complement our computing investment with data intensive infrastructure and interactive services to enable a richer more impact range of science.

We could evolve a world leading eResearch ecosystem if we are more ambitious and less risk adverse, and move quickly by building on these foundations. To deliver broad scale sector impact needs enriched scope and a more ambitious scale.

Our key challenge – Connectivity

Question 10: Do you agree that a key challenge for the RSI system is enabling stronger connections? Why or why not?

Please type your submission below.

RSI system incentives are finely tuned to support a competitive model. This competitive system is highly productive in generating research outputs. We have some strong foundations in our science advisory system, and our national research and infrastructure collaborations, yet the system itself is often operating on frustrating principles, at small scale, and with curtailed ambition.

The science system is funded in a through full-cost funding, often at small scale which creates fragmentation and challenges connectivity. Newly adopted funding instruments are starting to address fragmentation, though by doing so only through targeted funding rather than more deliberate system level change, these new investments can run across the way the system is designed and optimised, creating tensions and cultural impediments to their efficiency and effectiveness.

To continue to progress connectivity and national collaborative investments, whether in research or in research infrastructure, we need to recognise the system level challenges these create, and adapt structures and incentives to enable stability and high performance. We need a shift in incentives to enable institutions to prioritise and embrace connectivity, sharing of their capabilities, and collaborations in the national interest.

We face challenges in governing investments operating at small scale. To establish and sustain desired connectivity and independent governance requires proportionally a large overhead given our typically modest levels of investment. Often to minimise these overheads we instead defer to vested interests to uphold principles of fairness and national interest. Such representative membership structures create challenging club-like dynamics of exclusion and strong self interest.

We have successes in infrastructure of establishing national governance protocols, such as NeSI's National Platforms Framework for governance over co-design of advanced research computing infrastructure assets. Yet even then institutions still leverage their positions for their own self interest and gains. A truly connected and collaborative sector wouldn't incentivse such self interest, it would encourage generous collaboration, whereby new opportunities by default are brought to any collaboration, to support evolution of scale and richness.

As a small advanced economy, knowing when to compete and when to collaborate could be one of our greatest strengths, ensuring an optimised system which enables both.

Guiding Policy – Excellence

Question 11:	Do you agree with the definition of excellence presented here as the best thing possible in its context? Why or why not?
Question 12:	How can we achieve diversity within our research workforce? What are the current barriers preventing a diverse range of talent from thriving in the RSI system?
Question 13:	Do you agree that excellence must be seen in a global context, and draw from the best technology, people, and ideas internationally? Why or why not?
Question 14:	Do you agree that excellence is strengthened by stronger connections?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Citations from research outputs supported by NeSI are evidence of advanced eResearch capabilities underpinning excellence in many fields - in some cases as a competitive necessity, in others as a key differentiator. This is in line with other similar analyses internationally where advanced research computing is seen to significantly improve research excellence and impact.

Yet access to and skills in advanced technologies aren't openly available to all, creating imbalances of access and limiting opportunities across the sector. Matching excellent science with innovative eResearch requires an ability to engage and partner with a diverse range of researcher needs and skills, demanding advanced technical knowledge supported by power skills in relations, influence, and collaboration.

We attract top talent in our advanced technology investments, yet we constrain their resources and moderate their opportunities to perform at their best in support of excellence in research. eResearch in a global context is highly innovative, creating new digital tools, instruments, methods and practices, and in many areas being an influential voice and vehicle for culture change.

We need a scale of teams that can not only efficiently operate the infrastructures and methods of today. We need mindsets and capacities to rapidly discover, acquire, and translate the best of these innovations into our science system to underpin excellence in a broad range of sciences. We need a richness and scale of research infrastructure and eResearch which opens up new frontiers and doesn't constrain thinking.

Currently our scale and scope of national eResearch capabilities are based on our initial investments and funding levels across 2006-2010. With almost 10 years of investment in each major investment, sector demand has developed and needs have evolved. We now have emerging choke points, contestability for resources, and a more competitive culture emerging in access regimes, despite a common view that we're still at the early stage of adoption and diffusion of advanced research computing in the sector.

There are clear signs of needs for a richer more interactive and data-intensive set of infrastructure capabilities and services to serve the emerging variety of needs across communities, and to harness the best of international innnovations to underpin excellence and novelty in science.

With universities becoming strongly research led in their teaching practice, there is a far higher rate of contention for limited research funds as institutions drive traditional research incentives into a broader academic teaching staff. A key question is of the balance between the RSI and Tertiary Education strategies, as to whether the balance of funding across both of these portfolios is in fact in balance, recognizing that growth in academic teaching by necessity for universities means a growth in researchers competing for research funds.

Guiding Policy – Impact

Question 15: How can we improve the way we measure the impact of research?

Please type your submission below.

We support maintaining the focus on improving the way the sector measures impact, including the foundations in administrative data collection being developed through NZRIS. Case studies are the gold standard internationally, and these can be enriched with NZRIS data to provide greater linkage and deeper insight and inference.

International practice is turning to a richer view of alternative metrics beyond traditional citation measures, including through measures of outreach, application, and adoption.

There is a need to adopt economic measures both quantitative and qualitative in form. While sector investments can and should continue to exemplify their work through case studies, there needs to be clearer means of reviewing and evaluating investments. Current approaches to review and evaluation appear ad hoc, going from investment to investment with a pattern of unsatisfactory analyses and no clear standard or expectation from MBIE.

Guiding Policy – Connections

Question 16:	Where do you think weak connections currently exist, and what are the barriers to connections at present?
Question 17:	What actions will stimulate more connectivity between parts of the RSI system?
Question 18:	How could we improve connections between people within the RSI system and people outside it, including users of innovation, and international experts, business communities, and markets?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

We have many world leading communities already capable in applying advanced technologies within their research. However we have few if any incentives for these researchers or communities to share their skills and practices with others within their own disciplines or beyond, other than in service of achieving their own research goals. There is little drive and no incentive for these forms of openness given the fragmented and highly competitive nature of the funding system. While there are clear examples of generous and altruistic behaviours across the sector, these aren't rewarded directly, and would seem to be the exception rather than the rule.

The science system has recognized this challenge, and attempted to address it through mission-led investments such as National Science Challenges as one prominent example. Yet the additional funding into these organisations has proportionally added significant overhead in terms of governance and coordination, for in some cases relatively modest gains in funding support for the conduct of research. This creates a clear tension between the goals of national collaboration, and the valuing of such connections by those who seek to deliver more and better science. This is perhaps an area where scaling-up makes sense, lifting the ratio of science delivered to the overhead costs of connections, coordination, governance, enagement, etc. Through such scaling up, the value of participating in such collaborative networks is incentivised and reinforced, and these approaches would be more broadly embraced and their sophistication fully exploited.

Another area where we coordinate these capabilities is into shared infrastructure investment "clubs". In this area the common co-funding model for such collaborations leaves only marginal direct benefit for the club members while foregoing autononmy and requiring sharing of their capabilities and assets.

These peak facilities are typically unique and strategic for the science system, with Government looking for broader access and use sector wide. Government will look to invest to open- and scale-up these capabilities and assets for use by other stakeholders outside their club membership. This scaling-up investment offers very little additional incentive to the club members, while creating a disparity in cost structures between those co-funding founding investors and other sector users accessing via payment or open access schemes. Such disparities significantly undermine the generosity needed of investors / partners / collaborators to diffuse their advanced capabilities into the RSI system.

Ideally we should have strong incentives for diffusing adavanced capabilities across our science system as these often underpin novelty and risk taking in science. We could distinguish ourselves by removing artificial scarcity of such common goods in areas where we see strong value and opportunities to scale. We could shift from a model of scarcity focusing on competition and creating esteem and reputation, to a broader abundance of supply of such advanced capabilities with access and availability set at levels which underpin excellence and scale.

On a tactical note, there are missing connections during grant bidding processes. This is particularly true for larger grant programmes which have the means of coordinating resources into supporting innovation and specialisation in infrastructure capabilities. Where we have national investments in shared infrastructure (we only have a few) we should require explicit addressing of the use of these infrastructures as fit for purpose to enable any proposed research, including requiring letters of support from any relevant infrastructure organisations. It makes little sense to invest into high risk shared strategic assets and capabilities, and then allow for user communities funded from the same sources to coordinate their investments outside of these strategic investments. This could be a key mechanism to building scale, and to driving innovation into existing investments so the evolve to meet diverse needs. Driving sector connections through proactive and joint planning would make a significant difference to current approaches which fragment funding and frustrate our ability to build scale and evolve fit for purpose scope.

In a broader sense, we should get better at choosing those things on which we compete, and those on which we collaborate. We should design parts of the science system to support those collaborations in a fundamentally different way to how we deliver contestably funded science, on different principles and incentives which drive the desired connectivity, collaboration, sharing, critical mass, and scale. The current mixed messages stem from a need for co-funding, and expectations of generosity from club members inside a highly competitive funding environment and on infrastructure which is congested and contested. Where institutions and communities have spent in some cases decades developing advanced capabilities, it makes little sense for them to share. There are not enough core resources, with collaborations in some sense forced on top of existing sector structures, with the end result being resources are stretched thin and the resulting contentions lead to a conservative and self-centred culture which undermines broader sector goals and diminishes impact.

Actions – Making New Zealand a Magnet for Talent

Question 19:	How can we better nurture and grow emerging researchers within New Zealand and offer stable career pathways to retain young talent in New Zealand?
Question 20:	How could we attract people with unique skills and experience from overseas to New Zealand?
Question 21:	What changes could be made to support career stability for researchers in New Zealand? What would be the advantages and disadvantages of these approaches?
Question 22:	Do you agree with the initiatives proposed in the Strategy to support and attract talented researchers and innovators? Are any changes needed for these initiatives to be successful? Are there any other initiatives needed to achieve these objectives?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Attracting talented people relies on having high performing environments and cultures, resources and infrastructure, and smart colleagues with interesting and challenging aspirations. We have many of these things in New Zealand, though there are key aspects of our sector which frustrate and undermine our ability to attract and retain top talent.

Within the context of advanced research computing globally, the attractor of having world class infrastructure capabilities and teams is well understood. NeSI and its Collaborators are successful at attracting global expertise and talent into New Zealand in areas where NeSI has capability and track record. Retaining these people has challenges, in particular where family pressures for work or community are challenging, and where tensions within our modes of sector Collaboration frustrate our ability to make strong progress towards our goals. Many of the dynamics which frustrate and diminish our effectiveness are most evident in their impact on talent.

As a public sector, our RSI sector needs the same recognition as other industries in the face of a global revolution in digital technologies, literacies, ethics, and capabilities. RSI needs MBIE's stewardship of its industry transformation, as already outlined for other industries in the industry plan on innovative industries in the Digital Age. The people types and mindsets needed for a diverse and innovative science system are evolving, adopting new career paths (Research Software / Data Engineers; Research Devops Engineers) in particular for skilled people who can help researchers get over the hump to do small scale computational work, or to do stretch science using computation. There is a need for people who can transform researchers' ideas into something real using advanced research computing infrastructure, to grow into research output, product, patent, etc. It will be very important to be able to meet the changing compute needs for rapid prototyping, and researchers will need domain specific support, all of which are highly desirable opportunities and attractors for talent.

Within research and advanced computing infrastructure, there are challenges in establishing career paths for researchers and for those enabling research. For researchers, there are limits to resources available via Merit schemes and few alternate options nationally, unlike other national ecosystems in bigger economies where longer histories of investment have created a highly heterogenous and dispersed landscape of investments and resourcing options. Our currently limited scale and scope of landscape in New Zealand limits the diversity and range of researchers supportable, and is a detractor to top talent. Meanwhile for those enabling research, there are few career choices due to the limited scale nationally – our most interesting opportunities at a national level operate at small scales of team, and in many cases are well below critical mass. This is even more the case within our institutions, where often only fractional resources can be afforded to support core research infrastructure, with little capacity to apply tactics for adoption and diffusion.

Emerging career paths for advanced computing specalists, research software engineers, research devops engineers, are increasingly being recognised in other national ecosystems. We see national investments into enabling groups in data science engineering, computational science, and services engineering across many countries. These centralised investments create new professional career paths which harness science sector knowledge combined with the best of industry expertise and architectures translated in to support science ambitions. These centralised investments complement the smaller scale and dispersed investments embedded in institutions and research communities. Both central and distributed teams of enablers aren't commonly supportable through direct science funding, rather needing to be coordinated out of already highly contested overheads.

Meanwhile in the digital domain, given the need to enable and support transformation, talent needs more than advanced technical skills. Talent also needs power skills, being those relational and social skills which influence, coach, and develop others in adopting advanced technologies into their research – in other words, computational "personal trainers". These are some of the differences between being a researcher and being in support of researchers – this researcher technician is a career path for researchers who move closer to the methods and the specialised instruments and infrastructures which enable these methods. They hold transferrable skills as research digital technicians, which can and should be diffused into sector research communities, and more widely into government, hospitals, and industries.

This unique combination of science backgrounds and thinking combined with advanced skills in data and computation are an area where other nations are making outsized investments, particularly due to the late recognition of a national need stewardship of digital transformation of research as a sector.

Actions – Connecting Research and Innovation

Question 23:	What elements will initiatives to strengthen connections between participants in the RSI system need to be successful?
Question 24:	What elements will initiatives to strengthen connections between participants in the RSI system and users of innovation need to be successful?
Question 25:	What elements will initiatives to strengthen connections between participants in the RSI system and international experts, business communities, and markets need to be successful?
Question 26:	Are there any themes, in addition to those proposed in the Strategy (research commercialisation and international connections), that we need to take into consideration?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

The current dominant competitive settings drive a transactional approach to relationships, connectivity, and collaboration. Researchers and institutions can't orient towards optimal national outcomes without transactional support: funding and contracts. This creates a transactional rather than collaborative culture, which impedes connections of people, data, institutions, career stages, and communities.

Alternate incentives are needed to support those situations where connectivity and innovation are the goals. The role of government is essential to providing stability for innovation. Collaborations take many years to build trust. Meanwhile there is lethargy in making such ambitious bids, as they require coordination and consultation across a broad range of stakeholders, which itself is expensive and hard to support, especially in the face of low success rates.

In particular where partnering with te ao Māori, it is essential to support community formation and partnership, and for this to be sustained over the long term. This is also true of mechanisms to support similar relations with our pacific neighbours. We need incentives and time horizons which fit with the need for connectivity and support the long lead and gestational times associated with innovation, for long term relational sustenance.

A further theme of open innovation embracing open science would set out a clear agenda towards public good and social value, while it would need to reconcile a posture of being open by default with adopting suitable regimes to manage things of a tapu and taonga status, and other forms of sensitive, private, or confidential considerations.

Actions – Start-up

Question 27: How can we better support the growth of start-ups?

Question 28: Do the initiatives proposed in the draft Strategy to support growth of start-ups need to be changed? Are there any other initiatives needed to support start-ups?

Question 29: What additional barriers, including regulatory barriers, exist that prevent start-ups and other businesses from conducting research and innovation?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Current incentives in the RSI system appear to drive protection of short term revenue models for IP without alternate avenues or funding models to support lowering or removing transaction costs, thereby fostering environments where entrepreneurial ecosystems might develop. Recent reviews such as the Prevailing Weather report capture some of these dynamics, while recognizing the inherent costs involved in restructure incentives to achieve these goals.

In a more general sence, a good example of this is the lack of strong support for open data, attributed in most other national RSI systems as being an essential driver of innovation. While there were RSI programmes aimed at a stronger posture to support open data in research many years ago, these mostly stay constrained to aspects of environmental data, and are yet to be developed in most other areas.

Similar to the challenges around generous collaboration to realise broader national benefit, there are few incentives for research communities to prioritise industry capability transfer/diffusion over developing their own capabilities, especially in cases whether such industry development would add additional competitive pressure on existing revenue sources e.g. in accessing and exploiting research data, or in detracting from a focus on research which addresses key incentives such as citations.

Meanwhile advanced computing capabilities (REANNZ, NeSI) could offer unique advantages for start-ups to access and build on the most advanced computing environments, with such environments likely to become more widely available in the medium term for industry globally. The way NeSI is setup today, it is an incremental change to leverage NeSI for these additional use cases and communities, though would require additional expertise and resources to ensure adoption and diffusion of high risk advanced technologies was successful and not seen as a burden by industry. It would also be advantageous to look at targeted funding through existing channels such as Calaghan Innovation to fund start-up for NeSI subscriptions and related organisational capability development.

Actions – Innovating for the public good

Question 30: How can we better support innovation for the public good?

Question 31: What public-good opportunities should our initiatives in this area be focused on?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Currently the relative priority of innovation for the public good isn't clear, with drivers around excellence and impact targeting more direct forms of value and return. Ensuring there is balance across these more or less direct forms of return will be essential.

Within the science system and institutions, reducing costs and barriers to realising broader and public benefit suggests some changes might be needed to incentives and performance expectations on our institutions.

In some cases, targeting public benefit might conflict with a need to sustain revenues and returns. A clear case for this sits in publicly funded research data, where a complex range of costs and incentives drives institutions to keep the highest value data holdings to themselves, to protect and sustain their current position, capabilities, and revenues.

A fundamental shift would be required to align New Zealand's science system with those of most other advanced economies, who are well down the path towards adopting principles of open innovation, and in particular ensuring publicly funded research is by default open. The one time costs of such a shift could see a dramatic shift in the posture of institutions towards enabling greater connectivity and collaboration, and driving more deliberately to broader benefit equations.

Actions – Scale up

Question 32: What is the best way to build scale in focused areas?

Question 33: Do the initiatives proposed in the Strategy to build scale in focused areas need to be changed? Are there any other initiatives needed to build scale?

Note: see following page to comment on possible areas of focus

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

We should prioritise incentives and other mechanisms which evolve a complete ecosystem of eResearch which operates at scale, has a scope which supports our largest drivers alongside innovation, and which is accessible across the sector.

We should provide clearer signals in the forms of stronger rewards and leverage to institutions who have built foundational capabilities and are open to sharing these, recognising their loss of competitive position through relinquishing exclusivity over these things.

We should support moving these research group and institutional capabilities through a pipeline of development at the edge of the sector, and migrating them into national access, and where appropriate consolidation and central public service provision as we have done with NeSI. We should leverage NeSI to provide such channels and pathways, and equip NeSI with the flexibility and resourcing to make this sort of innovation and scaling up a core contribution to the sector.

We should consolidate into existing areas which have shown success, scaling these up and providing an evolving mandate to support their innovation and development as they reach new target users and vary their offerings to meet these needs. Where we are seeing clear infrastructure and people limits in areas of common need, we should not constrain our ability to scale. Where we have successful models, we need to have explicitly available pathways to scaling up.

Co-funding models put significant constraints on our ability to scale, especially if the scale is required by newer communities, where co-funders have little to no incentive to invest. Co-funding models tend to drive conservative scales and scopes of investment, driving towards what co-funders can afford, and to a lowest common denominator based on co-funder rather than wider community needs.

Scale up – Choosing our areas of focus

For this draft iteration of the strategy, **we seek input on the selection of possible areas of focus**. We will consider establishing around five focus areas, but, depending on the eventual selection, are likely to introduce them over time, rather than immediately. In addition to the criteria set out in the Strategy document, we invite stakeholders to consider the following factors in their suggestions –

- The ambition of this strategy to focus efforts in the RSI portfolio at the global frontier of knowledge and innovation.
- Ways in which the RSI system can accelerate progress on the government's goals.
- The focus areas already determined by *From the Knowledge Wave to the Digital Age*.
- Work already underway where we are already seeking to build depth and scale in the RSI system.

The following areas could be a useful start, and are highlighted in *From the Knowledge Wave to the Digital Age:*

- **Aerospace**, including both autonomous vehicles and our growing space industry.
- **Renewable energy**, building on recent investments in the Advanced Energy Technology Platform.
- **Health technologies** to improve delivery of health services and explore opportunities in digital data-driven social and health research.

We invite comment on these suggestions and welcome input on other possible focus areas.

Please type your submission below.

In line with the industry plan on the Digital Age, MBIE should prioritise digital transformation of RSI workforce with a strong focus on computational and data-intensive methods to underpin a broad range of research endeavours. We need capacity building, critical mass capabilities, and a mix of centralised and distributed/embedded resources.

A key question is how do we scale digital literacies and computational/analytics capability building across communities and institutions. We have some good evidence of it working well, initially from within institutions, then migrating into NeSI, then enriching the ecosystem back into specific institutions and in strong partnerships with national research investments.

We need to connect these ideas with the enabling roles and career paths supporting science, notably in the areas of research software/data/devops engineering. Some national investments have established such centralised and shared research engineering resources, yet many indicate they are challenged to sustain their central software engineering capabilities due to shifting funder priorities, and there is no funding nor inventive for them to share these advanced capabilities and translate them into other communities. This is where a centralised group of people as enablers and computational "personal trainers" becomes essential, to facilitate cross community translation, and to maintain a criticial mass of expertise with a high level of maturity to coach and develop other communities. It will be essential to retain people types and mindsets which support flexibility, sustaining and evolving inline with the development of science goals and practices – we can't just fund new science to drive new capabilities, we need to also build and sustain capability, consolidating down from novel to reusable product – there is a complementary nature of researcher project developments vs teams who can scale up and diffuse specialised computational and analytical and other forms of science software engineering investments out to broader audiences.

In their use of advanced research computing the sector is scaling up, NeSI usage is scaling up and engagement is scaling up, though it is hitting the limits of what is supportable from the current investment. This is limiting the connectivity and diversity possible from the existing investment.

While NeSI was originally a scale up to achieve critical mass nationally, the current scale was establish a decade ago, and while computing power does have some natural scale up over time, the broad front of engagement and the diversity and domain specialisation of needs means this doesn't keep pace with the need for large scales of infrastructure and people.

Government should increase their investment in recognition of these successes and of developing need, and address the issues of contention and congestion and the resulting conservative cultures. The eResearch system needs to plan for proper funding for the upcoming flood of data, and do this in a way which complements existing investments in networks and advanced computing. It should explore ways to scale up which increasingly drive embedding of capabilities back into institutions and communities, through complementary investment models of balanced investments in core national capabilities centrally alongside embedded capabilities in a mutually supportive ecosystem model across institutional boundaries.

Actions – Towards an Extended Vision Mātauranga

This section of the draft Strategy signals our intention to consult and collaborate further with Māori stakeholders to co-design our responses and initiatives. From that perspective, we consider the signals in the draft Strategy to be a start, rather than a set of final decisions. Nonetheless, we are keen on initial feedback in the following areas.

Question 34: Does our suggested approach to extending Vision Mātauranga focus in the right five areas? If not, where should it focus?

Question 35: How can we ensure the RSI system is open to the best Māori thinkers and researchers?

Question 36: How can we ensure that Māori knowledge, culture, and worldviews are integrated throughout our RSI system?

Question 37: How can we strengthen connections between the RSI system and Māori businesses and enterprises?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

Connections and embracing of Māori knowledge, culture, practices, and expectations has specific implications in the digital realm. As more researchers become more successful with data collection from indigenous sources, there will be a need to store indigenous data which has different needs with regard to storage and privacy.

There is a rapidly growing need for existing infrastructures to evolve to support governance protocols and implement related controls to enable research in partnership with te ao Māori.

Funding schemes need to recognise that this adds necessary complexity to existing solutions, ensuring that existing investments are able to embrace and support diversity of needs and communities, rather than fragmenting solutions and communities and creating disparities and exclusion.

Actions – Building Firm Foundations

Question 38:	Do the current structures, funding, and policies encourage public research organisations to form a coordinated, dynamic network of research across the horizons of research and innovation? What changes might be made?
Question 39:	Is the CRI operating model appropriately designed to support dynamic, connected institutions and leading-edge research? What changes might be made?
Question 40:	What additional research and innovation infrastructure is necessary to achieve the goals of this Strategy? What opportunities are there to share infrastructure across institutions or with international partners?
Question 41:	What elements will initiatives in this area need to be successful?

Please type your submission below. If applicable, please indicate the question(s) to which you are responding.

There are perverse incentives operating in our structures, funding, and policies, including:

- Co-funding requirements for infrastructure which drive conservative rather than dynamic behaviours, and drive towards lowest common denominator environments rather than innovations in scope which support diversity, novelty, and a broad definition of excellence in science.
- Natural differences between University and CRI missions and cultures in our highly competitive funding environment can create divisions and a lack of empathy and mutual respect, leading to dysfunctional cultures and a lack of connection.
- Revenue and return requirements for CRI's create a transactional focus and culture, which undermines higher principles of national interest and collaboration outside of a scope which supports self centred revenue generation for institutions.
- A lack of resources and funding are at the core of the system problems. The sheer number of institutions, communities, and funding structures, all of which make sense in concept, create a contest for resources and a fragmented ecosystem.
- Sustaining capability and skill is a challenge in the face of ongoing declines in funding in real terms. Innovation, dynamisim, and altruism come a distant second.

Research and innovation infrastructure is seen as assets, and then the sector under invests in skills because assets are more tangible and affordable.

We have little investment into digital transformation of the sector, especially with regard to the transformational aspects of developing people, skills, cultures, and capabilities fit for the Digital Age. Current structures around digital literacy and data management are inadequate, so this needs to be looked at.

eResearch needs to operate on a more sustainable financial footing, on time frames which underpin and support sector continuity and public good. The NeSI collaboration is an example of what can be done. There is growing constituency in support of NeSI, with small though increasing numbers of institutions and communities knocking on NeSI's door and wanting to use their services. There is good collaboration around infrastructure, though scale and scope constraints can quickly negate such collaborative national intent.

Actions – General

Question 42: How should the Government prioritise the areas of action, and the initiatives proposed under each area?

Please type your submission below.

Development of science and innovation capabilities and impacts takes time. Global challenges will only increase.

The Government should be courageous with regard to funding science.

We can learn from other jurisdictions, and acquire emerging practices in data intensive and computational and digital literacies to advance our own science.

We should build on broadly enabling investments in eResearch. There is low risk in investments with strong track records like NeSI.

We need to leverage both scope and scale, of infrastructure and people, and drive interventions which consolidate core resources while embedding capabilities into resilient communities and institutions.

General

Question 43: Do you have any other comments on the Strategy which have not yet been addressed?

Please type your submission below.

We need to cover the fields of science and application widely, while in areas where we have advantages that other countries don't we should make ambitious investments.