Manaaki Whenua
Landcare Research

MANAAKI WHENUA'S ORGANISATIONAL RESPONSE TO TE ARA PAERANGI

Manaaki Whenua welcomes Te Ara Paerangi. We agree the status quo in the public research system is no longer fit-for-purpose. We look forward to on-going discussions with MBIE and recommend that the reforms are focussed on creating impact for Aotearoa. This necessitates a co-development approach with mana whenua, with the Crown Research Institutes and with our stakeholders, partners and clients with whom we have invested 30 years of relationship development.

The Basis of this MWLR Submission

1. The MWLR submission concerns public research organisations only (when discussing institutions). Although partnership with (NZ and international) universities is critical to our success in providing solutions for enduring environmental protection and enhancement, our cohesion around our "mission" necessitates a different platform to that associated with either the "critic and conscience" role or the provision of excellent tertiary education, both being central to universities. We do, however, support the strengthening of partnerships with universities to create a more cohesive pipeline of mission-aligned researchers.
2. The MWLR submission supports public research organisations giving effect to the principles of Te Tiriti o Waitangi. This means that national research priorities should be set in partnership with Māori. In addition, we support Te Pūtahitanga's recommendation of the establishment of a Mātauranga Māori Commission with the ability to formulate and commission research independently (to Crown agencies).
3. The MWLR submission reflects our core operation – to conduct research on environmental issues, opportunities and solutions. We take seriously our contribution to New Zealanders' wellbeing. We are representative of the part of the sector that is largely Government-facing. 93% of our research is either funded by, or, undertaken in partnership with Crown agencies. Where we focus on the fundamental and applied horizons of research endeavour, our partnerships bring us into the "leverage proven ideas" research horizon and our partners implement policy and other solutions to create the impact we are all seeking for Aotearoa.

We broadly agree with the aspirations MBIE has identified as desirable in research systems in small, advanced economies. However, the basis for our submission concerns the following aspirations (which relate more strongly to a public-sector facing institution):

- Give effect to Te Tiriti o Waitangi
- Reduce complexity and fragmentation and increase organisational stability
- Provide for agility in research priorities
- Contribute to a productive, sustainable and inclusive economy
- Achieve impact using a partnership approach, whereby research organisations support partners to achieve their organisational impacts
- Support Government agencies with the research required to create and implement evidence-based policy

- Ensure equivalence in overhead costs between public organisations when bidding competitively for Government research funding (i.e., universities and public research organisations should "cost" the same for the labour components of equivalent research roles)
- Provide a work environment that attracts and retains diverse talent across the H3-H1 Frascati and research support spectrum (modern research institutes require multi-disciplinary teams to create impact).

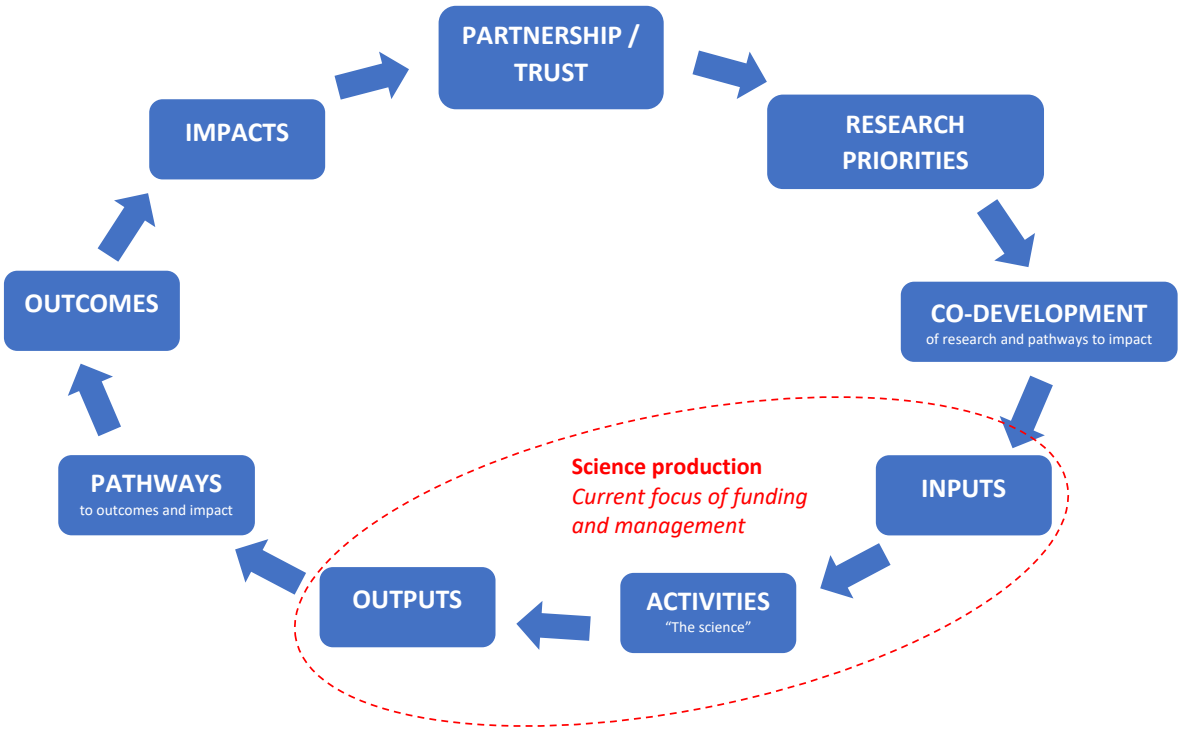
Summary of Key Recommendations

- Prioritise alignment with the principles of Te Tiriti o Waitangi. This includes the establishment of a Commission of Mātauranga Māori and co-development of national priorities outside of this.
- Keep the public system reforms focussed on impact creation – this requires a facilitated process to set national priorities with clear outcomes that precede impact. Learn from what has worked, and not worked, in National Science Challenges and platforms like Outcome-Based Investments and Strategic Science Investment Funding.
- Ensure complete clarity of the "mission" of each research organisation – this could be enhanced by a focus on one or more "National Priority Research Platforms", but the organisations still need to have their own identities, distinct from those of one or more platforms.
- To incentivise collaborative, adaptive and agile public service-facing research institutions, all research support staff salaries and 70% of research staff salaries should be provided by a base grant focussed on national research priorities such that researchers are free to meet with researchers from other institutes, share ideas etc without the anxiety that they need a "job code" to pay for their time. This grant needs to be constrained by clear and transparent performance indicators. National research priorities (and associated researcher salary grants) should be able to change to different priorities according to changing Government (and mana whenua) needs.
- Ensure public research organisations are well-connected with universities through joint initiatives that ensure a pipeline of human capital development, focussed on impact creation. This would provide a complementary career path to academic research.
- To ensure innovation and maintain a focus on the principles of full cost recovery, a component of competitive funding is necessary that depends upon a "contest of ideas" to ensure researchers are continuing to engage with the research community domestically and internationally (especially important for H3 research). This can add to the research staff salary budget (to bring to 100% along with commercial contracts).
- Implement common data management practices, platforms, access to HPC/capability development and a central spatial digital dataset.
- Implement a national strategy for Databases and Collections, starting with mana whenua engagement for the existing 25 NSDCs. There needs to be a process for extending this strategy to/including additional collections and databases also.
- Apply a different operational model for NSDCs whereby operations are funded for all reasonable costs within the national strategy of prioritisation, including digitisation. These Collections and Databases must maintain very strong links to the research community but increase their partnership with mana whenua, public and commercial entities, where appropriate.

Impact should be central to public-facing research organisations

We follow the lead of the Impact Planning and Evaluation Network (a pan-CRI group dedicated to increasing our collective impact). They define impact as "creating changes to economy, society or environment, beyond contribution to knowledge and skills in research organisations". They have been studying the methods for achieving this and are now starting to train widely CRI scientists to better plan for, and achieve, impact. A simplified version (without the feedback loops) of their understanding of the impact process is:

Figure 1: How impact happens, versus 'science production'



We note that the current science system focusses on, and rewards, the activities within the red circle. A modern research organisation would hold impact achievement as its central aim. It would stand up multi-disciplinary teams (including marketers, project managers, HSE experts, relationship managers, designers etc as well experts across scientific disciplines and technical expertise) to ensure impact is achieved. In addition to multi-disciplinary in-house teams, impact requires iwi and hapū, policy makers, land managers and others to share in the co-development of the pathways to impact in order to ensure that the right research connects to outcomes and eventually impact.

The Pre-Seed Accelerator Fund (MBIE) has covered some of the outputs to pathways part of the process with a view to creating commercial impact. The commercial impact pathway also needs to be provided for.

ANSWERS TO CONSULTATION QUESTIONS

KEY QUESTION 1: What principles could be used to determine the scope and focus of research Priorities?

Te Tiriti principles should be used to determine the scope and focus of research Priorities. From there, the priorities should be those required to achieve the impacts agreed between tangata whenua and tangata tiriti.

We recommend that the principles of Te Tiriti o Waitangi should be the primary principles determining the scope and focus of research priorities. We support the recommendations of Te Pūtahitanga. In practice, this would mean the formation of an independent Mātauranga Māori Commission able to direct and commission research priorities for Te Ao Māori. In addition, we support a partnership approach (between Crown entities and mana whenua) for setting shared priorities where the interests are overlapping (we anticipate this being all areas outside those in focus in for the Mātauranga Māori commissioning interests). The Mātauranga Māori Commission could also work with regional hubs (of mātauranga practitioners) to assist their prioritisation.

We support the public research system focussing on "impact" as its primary purpose. Many things need to change to enable impact to be delivered. Some are detailed in Duncan (2020) and Duncan et al (2020). Applied integrative approaches or transdisciplinary approaches are thought necessary for achieving research impact or for addressing complex socio-ecological issues (Duncan et al 2020 and references therein). Duncan and co-authors have demonstrated that an extended Outcome Spaces Framework is useful for planning multiple outcomes from research and for assessing potential impact. We recommend that the appropriate time, investment, skillsets and governance are provided to maximise the potential for impact to be created through a prioritisation process.

KEY QUESTION 2:

A) What principles should guide a national research Priority-setting process?

Te Tiriti principles should be used to determine the scope and focus of research Priorities. We support the PCE recommendation of an independent Environmental Research Council.

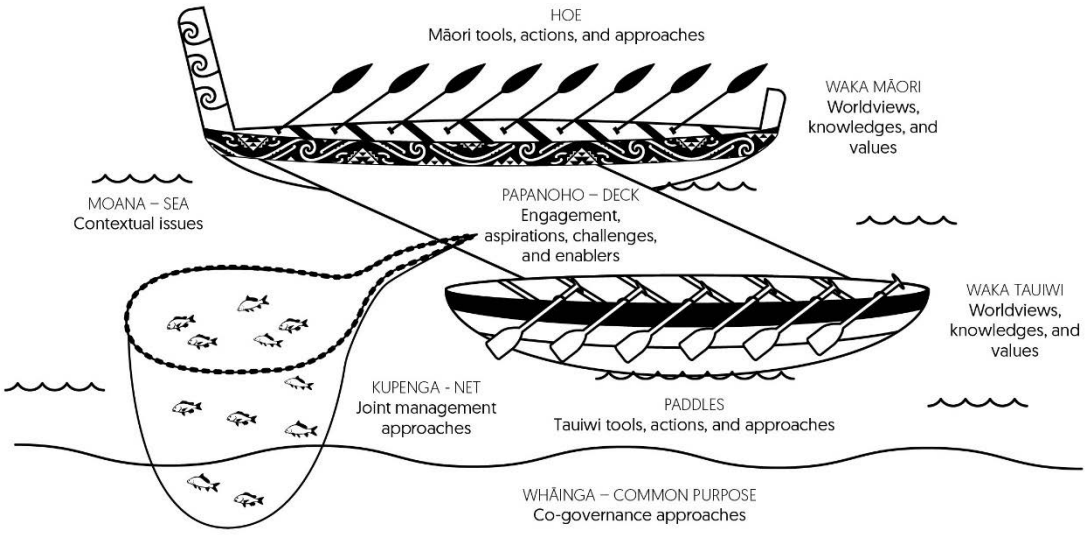
While we recommend that the principles of Te Tiriti o Waitangi should supply the overarching priority setting principles, we recommend that an independent (environmental) research council could broker the process between different Government agencies and other stakeholders to supply the "Waka Tauiwi" priorities.

B) How can this process best give effect to Te Tiriti?

We recommend that the principles of Te Tiriti o Waitangi should be the primary principles determining the scope and focus of research priorities. We support the recommendations of Te Pūtahitanga. In practice, this would mean the formation of an independent Mātauranga Māori Commission able to direct and commission research priorities for Te Ao Māori. In addition, we support a partnership approach (between Crown entities and mana whenua) for setting shared priorities where the interests are overlapping (we anticipate this being all areas outside those in focus in for the Mātauranga Māori commissioning interests).

With respect to setting the shared environmental priorities (between Te Tiriti partners) we recommend that shared impacts are first agreed using the framework of Maxwell et al (2021). An adapted version of this is shown in Figure 2. The papanoho (deck) is where the agreed impacts could be established between Māori and tauiwi.

Figure 2: Waka Taurua from Maxwell et al (2021).



The Waka Taurua provides for a waka Māori to sit in relationship with the waka tauiwi where priorities need to be set across both worldviews. This would apply to all national priorities for the Crown. However, provision also needs to be made for the Waka Māori to set and commission its own priorities, independent to the relational priority setting process.

We refer to Figure 1 for how priorities can be set, once shared impacts are agreed. With impact achievement as the central aim, groups responsible for delivering the impact must work together to agree the outcomes (from research) that would help them to deliver the impact. The research community must be at the table for helping to shape the actual research priorities as they have the knowledge to bridge between outcomes and a research agenda – they also know what has already been researched and needs to be adapted. Iwi, policy agencies and the many other actors that create impact (e.g., land managers, primary sector bodies, NGOs etc) need to provide clarity on what is to be achieved. A partnership approach between their representatives and representatives of research can then identify the research priorities that will lead through to pathways and outcomes.

The national (environmental) priorities need to be distilled to a single set that all Government agencies agree to. Different research strategies for each Government agency detract from national priorities and adds to fragmentation. In this we support the PCE recommendation of a National Environmental Council to oversee the process of prioritisation and to make recommendations to the investment fund. Deviation from their recommendations will need to be strongly justified if they represent the "national" view.

The strategy for each research priority needs to reflect the pathways required to ensure impact is eventually achieved – this will require cross-Government buy-in and many stakeholders to participate.

The research system needs to support research across the Frascati spectrum of H3 to H1, or MBIE's research horizons of "Generate New Ideas" (H3), "Develop Emerging Ideas" (H2), or "Leverage Proven Ideas" (H1) (MBIE, 2019). National research priorities depend, in part, on H3 research, while still maintaining an impact focus. Whilst some support for H3 research is essential within an impact-focussed research framework, we recommend that additional support for H3 research is also provided

outside of the (national priorities) framework. This horizon (H3) is where a contest of ideas is most appropriate. This is often the 'edge' from where tomorrow's solutions emerge. The MBIE Endeavour investment fund works well for H3 research and could include some alignment with National Priorities for part of the fund.

If national research priorities are to feature as a structuring element of the NZ public research system, it will be essential that the other (i.e., outside of MBIE) Government stakeholders co-develop and agree to the research priorities. Given the lack of over-arching strategy or mechanisms to connect "road maps" such as the Conservation and Environment Science roadmap, or the Primary Sector research roadmap to either CRI Strategic Science Investment Funding or MBIE Endeavour funding, Government agencies have been left to procure their own fully cost-recovered (by CRIs) H1 research. Whilst this is consistent with the draft RSIS (MBIE, 2019), the reality has been different Natural Resource Sector agencies procuring very similar pieces of work multiple times and usually from a slightly different combination of public research agencies, sometimes resulting in competing recommendations.

We can see the benefits associated with the PCE recommendation of a dedicated Environmental Research Council (PCE, 2020). Once priorities have been set, using collaborative principles (such as in the Outcome Spaces+ Framework), an Environmental Research Council could be responsible for overall strategy, investment and accountability. In some instances, an NRS agency may still commission a very specific piece of H1 research, aligned only with its policies and their implementation. Because of the existence of the base grant, Government agencies would only be funding the "marginal" costs, such that the cost for each research project would be less than half what is charged currently.

A funding model for H2-H1 research that we believe to be highly successful is MPI's Sustainable Land Management and Climate Change fund. A collaborative process (between the Ministry and research providers) was used to set priorities that advanced the Ministry's policy programme and were also tractable as research outputs and outcomes. MPI ruthlessly pursued "collaborative" principles to the extent that contracts were not signed until the requisite set of system expertise (across organisations) was reflected in proposals. Many contracts (especially earlier in the life of the fund) were large enough to support the transaction and programme management costs required to bring participants to a common understanding of outputs and outcomes, across differing organisational objectives. The one weakness in the system was its dependence on the status quo. Only research organisations with a track record of working with the Ministry on climate change mitigation and adaptation were invited to participate in the scoping exercise. If this type of model were to be followed, an opportunity for innovation and new teams to participate would need to be created and incentivised.

Connectivity is important at the level of a research priority - but we should also reflect the value in diversity of thought, approach etc. Having parallel/simultaneous streams of research within a priority area will be critical to increasing chances of high impact outcomes. This shouldn't be mistaken for "duplication". (The trialling of different approaches is standard for both research and product innovation.)

KEY QUESTION 4: How would you like to be engaged? (Question for Māori staff only)

This question has been answered exclusively by our kairangahau Māori. *Please refer to MWLR's Manaaki Taiao supplementary submission.*

KEY QUESTION 5: What are your thoughts on how to enable and protect mātauranga Māori in the research system?

This question has been answered exclusively by our kairangahau Māori. *Please refer to MWLR's Manaaki Taiao supplementary submission.*

KEY QUESTION 6: What are your thoughts on regionally based Māori knowledge hubs?

This question has been answered by our kairangahau Māori. They suggest that "Strategic development of Māori research priorities alongside the allocation of funding for research could be carried out by regionally based hubs governed by hapū/iwi and managed by local leaders. This model is similar to Te Mātāwai."

Please refer to MWLR's Manaaki Taiao supplementary submission.

We note that the (current) geographic spread of Crown Research Institutes is very compatible with regionally-based Māori knowledge hubs. Having researchers "in place" is the best way to form enduring partnerships with regionally based hubs governed by hapū/iwi and managed by local Māori leaders. More could be done by CRIs to offer a single "open door" to hapū and iwi within a rohe, such that this door could lead to all of the CRIs. Alongside this should be a programme of active outreach – joint CRI approaches to marae whereby the researchers go to the people and listen to their concerns and aspirations.

KEY QUESTION 7: How should we determine what constitutes a core function and how should core functions be funded?

We agree that core functions, those providing repeatable services to Government, should operate under a different model to research functions, but be tightly coupled to research.

We could argue that all research should be seen as a core function of a public research organisation. There is little doubt that inflation-proofed core funding can have a huge role in workforce resilience and career development.

However, with the definition and examples given by MBIE, we agree that core functions require a different business model to research functions. They need to function according to a multi-year strategy and be able to prioritise service improvements in a phased manner, within a known budget. Being dependent on a competitive research bidding process to provide part of a service improvement leads to frustration from service users and a lack of accessibility to publically-funded data. However, the core functions must continue a very close alignment with research programmes. This partnership ensures access to advances in technology that make core functions easier and more cost-effective to deliver. The relationship also ensures that advances in understanding may be reflected in the way data are collected or curated by a core function, and above all, ensures that data collected are continually used in research. Their on-going research use should be one of the measures by which they are evaluated regularly.

Core functions should be supported by dedicated Crown funding that covers all reasonable costs associated with their provision.

The rest of our answer relates only to Collections and Databases. MWLR is enacting a Collections strategy that will deliver to the Principles of Te Tiriti o Waitangi. This will mean changing the governance structure to reflect Māori participation, interests and priorities. An integrated strategy will be developed for all of our collections, and activity prioritised according to our new governance structure. We will be exploring "repatriation" by relational, virtual or physical means. We accept our Science Advisory Panel advice that "a Māori vision for the collections would be to Connect (all knowledge systems in a way that the collections have meaning for both Treaty partners – the way in which data are collected, prioritised, digitised and put to use is currently one-sided), Collectivise and Create (values, benefit, knowledge) for mana whenua, community groups and scientists in a deliberative way". Our intention is to reform according to these principles – we recommend they be adopted by an integrated national Collections strategy.

We believe that databases should deliver to FAIR and CARE principles, wherever possible (Carroll et al, 2021). FAIR stands for Findable, Accessible, Interoperable and Reusable. CARE stands for Collective benefit, (indigenous people's) Authority to Control, Responsibility (of institutions to engage respectfully) and indigenous people's Ethics to inform data use across time. Where Collections and Databases relate to each other, they must remain together – divergence leads to inconsistent practice, lack of traceability or ability to check provenance, and in the worst instances, mistakes in nomenclature.

KEY QUESTION 8: 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?

Base grant funding would improve stability and resilience of organisations and improve collaboration between organisations. This should include a substantial proportion of researcher salaries and be focussed around national priorities – potentially a base grant for non-attributable costs plus a research salary grant associated with national priorities.

Yes, a base grant funding model would improve the stability and resilience of research organisations. We are recommending that the base grant extends beyond non-attributable costs and into science salaries, to approximately 70% of the organisation's science salaries. (The remaining 30% of the science salaries could come from contestable grants and commercial contracts.) We believe this is necessary to achieve the aspirations outlined in the Introduction. Providing stability and resilience in the science salary base is the most substantial system lever for improving connectivity, collaboration and reducing fragmentation, competition and complexity in the system.

We recommend the grant funding for science salaries be conditional upon measured delivery to national research priorities. This could follow the SSIF or Outcome-Based-Investment models (but sit across institutions), but with far greater direct input to co-development from all relevant stakeholders. We recommend that MBIE reserve the right to change the national research priorities, with a well-signalled (2+ years) exit such that organisations could retrain their capability for different priorities or reduce capability (also using a clearly articulated process).

Only some form of base grant funding could guarantee that nationally-critical capability be retained for emergencies or for re-emerging priorities. Some of the base salary grant would need to be allocated to a portion of such capabilities at the times they were not considered "national priorities", or else the risk is of losing capability that re-emerges as a priority a few short years later.

With 70% science salary funding and non-attributable costs covered, public research organisations would retain flexibility to explore H3 research horizons through contestable grants and commercial research (H1) through direct funding from industry.

The extent of the resilience would depend on the extent of the base grant. If the grant extended solely to non-attributable costs on MBIE-funded research, Manaaki Whenua would cover less than 25% of our status quo (not inflation-proofed) cost base. We would therefore charge a little less overhead for MBIE revenue won and could cover a few more hours for our researchers. In effect, covering only these costs would make very little difference to the size of bids required to fund researchers and would make no tangible difference to Government agency procurement of our services. If the grant for non-attributable costs were to extend to all Government research, 31% of our cost base would be covered. This suggests that "research costs per hour" could drop by 30% for Government agencies, if only non-attributable costs for direct Government research is covered.

A significant overhead cost currently is the proportion of researcher time that is not directly attributable to one or more clients (c. 35% of a researcher's time or 13% of our total cost base). This is outside of the time associated with annual leave and public holidays (an additional 20% of a researcher's time).

The main activities undertaken by researchers on "non-chargeable time" are bidding, relationship management (with iwi and hapū, clients/partners, collaborators), project accountability (overseeing clusters of projects to meet MBIE accountability standards and HSE standards), training and professional development and supervising/mentoring other research staff.

The omni-present need to bid for research funding (93% of ours aligns to national priorities already, as indicated by the extent of Government funding) to support non-attributed/indirect costs, depreciation, infrastructure and necessary, but not directly productive, activity leaves researchers with a sense of being "self-employed" but at an unsustainably high charge-out rate. The flow-on effect is fragmentation of researchers into multiple projects so that no single project needs to support the overhead cost. Being split across a minimum of 5, and at worst, over 25 projects in a year leads to a high rate of burn-out and very poor job satisfaction.

However, we do see that some degree of contestability in national research priorities (maybe associated with platforms) could be dependent on both novel and collaborative ideas to ensure new teams are incentivised to put their best ideas together.

KEY QUESTION 9: How do we design collaborative, adaptive and agile research institutions that will serve our current and future needs?

We support sharing of systems between public research organisations and suggest that base grant funding of a significant portion of science salaries would make the institutions more collaborative and adaptive, instead of being locked into a non-strategic project by project horizon. Public research organisations must be mission-led, with impact creation their primary focus.

We are open to all possibilities on whether current institutions should be improved, evolved or dispensed with in favour of new organisations. We definitely support the idea that administrative systems/contracting mechanisms etc should be standardised between institutions.

In their favour, Crown Research Institutes have a proud history of mission-led research where the majority of staff are committed to the purpose of the organisation. Each CRI has its own distinctive culture. Our experience with academic institutions is that "research mission" (as opposed to teaching mission) is defined at a more granular level (individual laboratories/sub-sections of schools etc). This allegiance within a CRI takes years to build and constant vigilance to ensure the alignment to mission is not lost. We suggest this is easier to build in a smaller institute with a distinct focus on a narrower research area. However, the disadvantage of smaller institutes is that all the compliance requirements are the same as in a larger institute without the economy of scale.

Features we believe would incentivise collaborative, adaptive and agile research institutions (where they are public-sector facing) are:

- complete clarity of the "mission" of each research institute - this could be enhanced by a focus on one or more "National Priority Research Platforms", but the institute still needs to have its own identity, distinct from that of one or more platforms
- an inflation-adjusted base grant with the following benefits:
    - all support staff and 70% of research staff salaries provided by a base grant such that researchers are free to meet with researchers from other institutes, share ideas etc without the anxiety that they need a "job code" to pay for their time
    - a component of research staff salaries provided by a base grant such that key researchers can maintain external relationships in order to adapt to changing priorities/needs of partners

- a component of research staff salaries provided by a base grant such that all researchers have "time to think" as this is the true basis of innovation, and is critical to knowledge workers' motivation ("mastery" according to Pink, 2011)

- a component of competitive funding that depends upon a "contest of ideas" to support researchers to continue to engage with the research community domestically and internationally (especially important for H3 research)
- a "no cost to researcher" programme of secondments between research institutes (including universities) and partner organisations such as Government agencies. This could involve short-term single-issue secondments suitable for early-mid career researchers into Government agencies and vice versa. It could also involve longer-term arrangements for mid-senior career researchers who could contribute to a range of policy questions. The current cost to researchers in this situation is they usually lose their research funding base during the secondment and spend much time building this up again upon return. This could simply be achieved as a component of a base grant.

We support measuring the return on investment in RSI, with respect to achieving impact. Setting the system to achieve this, and measuring it, will significantly change its mode of operation. Additionally, this is where diversity and inclusion could be further incentivised.

Much has been made of the downside of CRIs sitting within the Companies Act – underpinning this discussion appears to be the hypothesis that this framework drives competitive behaviour between CRIs. We find little evidence for this – Boards very rarely advocate for "profit" maximisation to the detriment of collegial relationships between researchers. The current competition is largely driven by a need to shore up science salaries – one organisation winning a particular grant helps them to ensure that a section of their workforce can continue to be employed for another 5 years.

Certainly, the current benefits of the Companies Act are that the Board of Directors is independent, and that full transparency of the business model/cost structure is achieved. We applaud the recent emphasis on cross-appointments of Directors between CRIs. This will further enhance collaboration/standardisation of some systems and strategic direction.

KEY QUESTION 10: How can institutions be designed or incentivised to better support capability, skills and workforce development?

An inflation-proofed base grant would enable public research organisations to more consistently provide for professional development of their staff, rather than being dependent on yearly margins/profitability. Research organisations should embed highly skilled research support staff within impact-focussed projects. Funding criteria can set the expectations for workforce development. Dedicated fellowships (post-doctoral and otherwise) should be provided for workforce pathways. Early Career Researchers should not be expected to have more than one short-term post-doctoral experience within New Zealand within their career.

We suggest that the existing workforce development initiatives of CRIs are retained and enhanced by public research organisations. For example, Manaaki Whenua currently provides the following support for early career researchers: line management by a person in their research discipline (or close to it) that helps them to manage their time, plan their career and go after development opportunities. In addition, most of our papers are co-authored by senior researchers within our organisation or at collaborating universities who contribute mentorship in writing. Where possible, there is additional input into their science from a Principal Researcher. We support their participation in domestic conferences (whether presenting or not) and they could expect our support in attending at least one international conference in three years (COVID permitting). Further, we provide or support a range of internal and external

training opportunities, such as HSE (First Aid, 4WD training), "Plain English", te reo me ona tikanga, "R" coding, data carpentry etc. These types of courses are available to all our staff, not just researchers.

While similar opportunities are provided for mid-career researchers (and support leaders) alongside leadership training and skills to improve bidding success, their fragmentation and general sense of pressure often precludes them from feeling they have the time to avail themselves of all that is on offer. We feel that the base grant that covers at least a component of researchers' time would help to incentivise professional development. We also advocate a programme whereby some mid-career researchers could spend time in the lab or office of either domestic or international collaborators. Our experience is that this is a sure pathway to "fast-following" some of the newest techniques and approaches in our science that have been developed elsewhere, and can lead to novel products where our research staff bring a deep understanding of the aims of our partners and the collaborator enjoys the challenge of the "design constraints" to apply new techniques to. This is currently almost impossible to fund (because of the need to account for "hours" in client-funded projects) unless a researcher uses annual or unpaid leave to cover their time.

A system focussed on impact needs to also develop highly performing teams, comprised of talent spanning multiple disciplines (not just research). Researchers may be drawn to working in teams that are famous for leading edge research - but they may also be drawn to working in teams that include experts in entrepreneurship, marketing, technology etc who are crafting outputs for industry based on research, or responding to a design challenge. Any research organisation is also totally dependent on its skilled and dedicated technical workforce – career pathways are essential for this workforce component also. We support the continuation of a scheme like the QEII technician's exchange to support technicians also acquiring new skills in other organisations.

Related to this is the need to recognise "excellence" within organisations across the range of skills. In addition to scholarship we need to recognise relationship building, cultural competency, public engagement, technical excellence, commercialisation etc. Further, salaries need to achieve parity with Government agencies and universities, sister-organisations requiring similar skill levels.

If research organisations are only funded for 70% of their salaries and seek additional FTE through competitive bidding the organisation will need to balance the opportunity of appointing new staff against the risk of not being able to pay them (or other capability no longer critical to national priorities). In some instances, we will continue to have fixed term roles for early career researchers or shorter term contracts. We believe this is acceptable for early career researchers (to be consistent with international post-doctoral models) as long as the research organisations are supporting their career development with excellent mentoring and professional development opportunities while in fixed term roles, and they are only expected to experience this once in their career. A proportion of the fixed-term researchers would move to open-term contracts where resignations or retirements occurred elsewhere in the organisation, and when other research foci were discontinued, consistent with national priorities. Otherwise, the excellent career development would enable individuals to move on to other public research organisations, universities, policy agencies etc.

We support the suggestion that the future system provides dedicated workforce pathway funding. In particular, a centrally-funded post-doctoral programme would provide a helpful bridge between a PhD and the practice of being a researcher. We recommend adding a dedicated fellowship scheme to improve diversity and inclusion, including for parents returning from an extended period of childcare, or for researchers coming back into a research organisation after an extended spell in an affiliated Government agency or similar.

KEY QUESTION 11: How should we make decisions on large property and capital investments under a more coordinated approach?

Shared impacts of organisations and co-planning should guide any centralised approach to large property investments. Organisations need operational freedom to invest in all but the largest equipment purchases.

We support a more centralised approach to large property and capital investments but advocate for strong involvement of the interested parties through a facilitated approach. Organisations' base grants should cover basic infrastructure (scientific equipment) up to a threshold (we recommend $500,000) in order that an organisation has freedom to operate. We would like any system to maintain a "full cost understanding" by public research organisations, such that provision is made to avoid the erosion in expenditure in property and laboratories that characterised the later days of the DSIR.

KEY QUESTION 12: How do we design Tiriti-enabled institutions?

Tiriti-enabled institutions will require the wisdom of our Kaihautū or Pou Ārahi during the design phase. The process itself of being Tiriti-enabled also must be supported (funded) for all parties involved, especially mana whenua.

Again we support the Te Pūtahitanga approach of independent structures (and putea) that address Māori priorities in addition to a partnership approach within institutions. This should extend to all levels of the institutions and include partnerships with existing experts in priming the pipeline of Māori researchers (such as Pūhoro STEM academy).

We seek increased Māori participation in governance, leadership and research activities within institutions as well as independence through a Mātauranga Māori commission and regional hubs of mātauranga practice.

We note the need for dedicated funding to help Māori organisations, the research sector and Government to work together collaboratively to develop the protocols needed to give effect to our Tiriti obligations and to provide a space for Māori to engage with a sense of equality. This work needs to include protocols around Māori data sovereignty, the Nagoya Protocol and Wai 262 alongside compulsory decolonisation training. Meaningful change will require deliberate and supported focus.

Manaaki Whenua is exploring one such approach through its "Being manuhiri" programme of practice for tauiwi researchers. These practices were developed by Manaaki Whenua researchers in the Biological Heritage National Science Challenge to support environment and recreation groups to be responsible manuhiri (guests and visitors) and to reflect on how best to prepare to arrive with care and respect for cherished places and their people.

Being Manuhiri » Manaaki Whenua (landcareresearch.co.nz)

KEY QUESTION 13: How do we better support knowledge exchange and impact generation? What should be the role of research institutions in transferring knowledge to operational environments and technologies?

We recommend drawing upon the dedicated CRI Impact Planning and Evaluation Network programme of impact creation to design these solutions.

Solving complex environmental problems requires a much broader skill-base than straight biophysical research. We recommend a prior (to setting priorities) investment into the best approaches to impact generation – the IPEN group has much to contribute here (we refer to their diagram on page 3 of this submission). National Science Challenges also have much wisdom to contribute. Some approaches, such as co-development, Outcome Spaces Framework+ and design thinking have already been tried

and evaluated (Duncan 2020, Duncan et al. 2020) but additional questions should be explored to optimise the system.

IPEN advocates the development of impact pathways. These need to be funded and extend across H3-H1 research horizons. A current example of a fund that explicitly provides for these impact pathways is the NZAGRC (NZ Agricultural Greenhouse Gas Research Centre) fund that builds the relationships explicitly between research providers and next users. Knowledge (or technology) should be passed in the most efficient way for the specific situation ranging from publication in relevant sources through policy briefs to Government and engagement with Government to protection (where warranted) and licencing or spin-out/start-up.

Another example is the original MBIE Smart Ideas fund. This provided a pathway to develop a proof-of-concept (and allowed for a "fast fail" of some ideas) and then an opportunity to up-scale the research with further funding. Further development of such a fund would be required to ensure the next users are involved in the evaluation of the proof-of-concept and are committed to the pathway to impact generation.

Envirolink has also resulted in some great "impact" both through stretching researchers' empathy of regional issues during proposal development, and for the Councils' implementation.

We suggest that once national priorities are established, that the mechanisms for their delivery are reviewed systematically with respect to what has been achieved across the H3-H1 spectrum. We need to identify what needs to continue in H3 as well as what needs to progress through the application pipeline or be dropped as it didn't work or has finished/reached its natural end.

KEY QUESTION 14: How should we include workforce considerations in the design of research Priorities?

Funding criteria can set the expectations for workforce considerations. Multi-disciplinary teams need to be enabled and rewarded for everybody's contributions to impact achievement.

Within our own CRI we have been observing a dramatic shift in the skillset required to deliver mission-focussed research. This has sometimes been described as a change in the dominance of "I" researchers to "T" researchers (Mountford et al 2017). The characteristics of the researchers are signified by the letters – from reductionist and deep in a single subject to having a ballast of depth but with the ability to branch out and think across disciplines, use data science to mine different types of data and above all to understand policy drivers and empathise with partner organisations and stakeholders including how their research presentation needs are transforming. "I" researchers have domain credibility and depth, but their transition to "T" researchers adds multi-disciplinary and inter-sectoral awareness and understanding (Mountford et al. 2017).

As is characteristic of workforce transitions everywhere, there has been considerable stress associated with this shift. Researchers complain of needing to be project managers, publicists, relationship managers, polymaths and marketers. We are undertaking a project to examine whether the construction of multi-disciplinary teams (each focussed on one or more research outcomes) would be a more efficient way to structure the research and research support workforce together. Our research support workforce is a highly skilled, mission-focussed resource. Without careful attention to the interaction between research and research support skillsets, stress will continue for researchers trying to be all things to all people and the research support workforce will become aloof to the missions and also not be able to work to their full potential.

As stated previously, we believe public research organisations also need to retain a component of the research workforce not so tightly coupled to the national priorities. We are mindful that "large teams develop and small teams disrupt science and technology" (Wu et al. 2019). Provision must be made for the retention and support of small satellite teams (they could work partly on national priorities and partly on independent H3 and H2 horizons' research). These teams would need to demonstrate "research excellence" according to international standards if they are decoupled from contributing directly to impact. Researchers could cycle in and out of these teams – sometimes working directly on the national priorities in multi-disciplinary teams and other times working in smaller, agile groups focused on generating new ideas. The alternation of these modes of working would provide good career stimulation/development for researchers.

KEY QUESTION 15: What impact would a base grant have on the research workforce?

If the base grant is set at the right level (i.e., includes a generous proportion of inflation-proofed research salaries) it will greatly reduce career precarity and will enable researchers to focus in fewer projects, thereby creating more job satisfaction and and more impact.

Institutions must retain responsibility for research (and research support) capability. This includes a serious approach to talent development. Our perspective on the ideal "development programme" differs a little from Te Ara Paerangi's review of "modern research systems in other small advanced economies". Serious talent development in those economies appears focussed on the university model of "pathways to establish programmes and teams". Aotearoa's very small population size and highly networked population of knowledge workers supports instead talent development (in public research organisations) that focuses on the mission and creating impact. Instead of proliferating teams of "I" researchers, we instead need to develop outcome-focussed teams that combine the deep expertise of I researchers with the inter- and trans-disciplinary expertise of "T" researchers (Mountford et al. 2017) and a highly skilled research support workforce.

A base grant that extends to a substantial proportion of researcher salaries for public facing research would be hugely beneficial to the research workforce and would increase the ability to focus on impact creation, collaboration to the extent of forming the right teams amongst research institutes (including universities) and would reduce complexity and fragmentation in the system. The base grant would include the "management" costs that our researchers currently spend (up to 35% of their time) on mentoring and developing others and continuing partnerships with stakeholders/partners.

Research organisations also need some operational funding (to conduct the actual research) that is non-contestable in order to cover the costs associated with researching the national priorities. This could be through a base grant or a research platform. We agree that research outside of the national priorities should adopt at least a marginal cost model and cover the research operating associated with that research. Some research should be fully costed, especially where it is in the H1 horizon. This is where the research is simply being tuned for market and there is likely to be on-going revenue for its application. We would see Government agencies benefiting from the covering of non-attributable costs in H1 research but covering the staff salaries to apply the research to their specific policy need where the research is outside the more general "national priority".

One of our most senior researchers (previously employed with a predecessor organisation to Manaaki Whenua) provides the following insights across a base grant versus a fully cost-recovered commercial funding model (we acknowledge that the changes are likely due to many things, not simply the funding model):

- "I believe productivity, in terms of numbers of reports, papers and impact, and quality of science outputs is significantly higher under the commercial model. In XX research institute, it was generally accepted that if a scientist produced one paper per year then that was acceptable

performance. Now, most scientists will be producing several papers and contract reports per year, although this varies across science disciplines and stage of career."

ACTION REQUIRED: Base grant must be conditional on clear performance targets, across both outputs and impacts.

- "This productivity gain is largely a result of the commercial rigour applied because of contracts with external clients…..commercial projects have a client, budget, and contracted outputs. So, I believe the good thing about the current CRI environment is the commercial rigour that is applied to project management and delivery."

  ACTION REQUIRED: Clear performance targets and client/stakeholder involvement in setting the outcomes required from a piece of research.

- "The downside of the competitive-commercial science environment is the significant waste of bidding time, and I think more importantly, the loss of opportunities to advance science because the priority setting and review process is flawed (reviewers often do not understand the science area they are reviewing). I firmly believe we could have advanced management of pests in NZ (as one example) if we had not been constrained by the funding system."

  ACTION REQUIRED: Base grant funding for a portion of researcher salaries and a national priority setting process that embeds "next users" and stakeholders to ensure the research is fit for purpose in an impact context rather than being solely judged for its "research novelty".

  Partner organisations need to be involved throughout the research programme and not just at the beginning and end.

KEY QUESTION 16: How do we design new funding mechanisms that strongly focus on workforce outcomes?

The funding criteria can set the workforce expectations. Dedicated workforce pathway funding would also assist career transitions and to promote diversity and inclusion.

The funding mechanism is the most significant lever in MBIE's toolbox. Researchers (and their support teams) are highly skilled and responsive to investment signals. Any research fund can stipulate that workforce outcomes are catered for. The signals need to be both clearly articulated and reinforced through actual funding appropriations. The workforce is highly tuned to "loopholes" which will be ruthlessly exploited if the signals do not match the actual appropriations.

Again the NZAGRC funding is an existing example of a fund aligned with workforce outcomes. The fund has criteria for science prioritisation that include addressing capability and infrastructure issues and stipulates dedicated funding for masters and PhD students.

The full cost recovery model has allowed Crown Research Institutes to invest in workforce outcomes from overhead margins. However, the dependence on an unpredictable competitive allocation of funding (MBIE Endeavour) has resulted in differentials between Crown Research Institutes and between years within a single Crown Research Institute. A base grant that includes a proportion of researcher salaries, aligned to clearly articulated workforce outcomes, would alleviate this issue.

KEY QUESTION 17: How do we support sustainable, efficient and enabling investment in research infrastructure?

Our response concerns three types of research infrastructure – property, equipment and Databases and Collections. However, we note that other components of research infrastructure should be consistent across organisations – including access to HPC and associated capability development, social ethics processes, mid-tier compute, spatial digital data and data management infrastructure and practices.

These items are fundamental for most research but especially for supporting data scientists – essential for the leading edge of discovery and impact creation. Databases and Collections are a unique type of infrastructure that can't be treated as a depreciating asset. Collections should appreciate in value through time through additions, taxonomic curation and databasing to increase accessibility.

Property

We are comfortable with a centralised approach to this as long as the sector is fully engaged with the strategy development. The current predisposition to co-location with universities (presumably to achieve a "recognition of the impact on human capital development adjacent to research") has already been trialled and failed in half of the co-locations of this Crown Research Institute. At its inception Manaaki Whenua campuses were all situated on the grounds of universities or shifted to achieve this alignment within the first few years of operation. In three of the six co-locations Manaaki Whenua was later asked to vacate grounds and find a new location away from the university, or the university itself shifted its geographic premises elsewhere. We stress that none of these instances resulted from a "falling out" – the circumstances simply reflected differing priorities between the two types of organisations (student facilities for universities versus staff work places for Manaaki Whenua).

Needless to say, this process has been hugely wasteful for the Crown in terms of relocation/capital expenditure. As an alternative, we are now looking to our Crown Research Institute partners for where co-location gains can be made. We note also that strategic planning has since occurred with all three of the same universities, such that we are now sharing the responsibility for developing cohorts of students in areas of shared research endeavour – we have not required physical co-location to achieve this. However, we agree that co-location should be explored (across any of the types of institution), wherever the institutions have shared aims built into joint strategy, could genuinely share infrastructure and could create more impact together.

We fully support joint planning for human capital development between public research organisations and universities. Given the rapidly evolving change in workforce expectations, it no longer seems relevant to depend on physical co-location for this level of collaboration. Instead, we support platforms shared between universities and public research organisations that focus on human capital development. Two such successful initiatives that we engage in are our Joint Graduate School in Biodiversity and Biosecurity that we share with the University of Auckland, and the Food Transitions 2050 Joint Postgraduate School that sits across the University of Canterbury, Lincoln University and our CRI partners AgResearch and Plant and Food Research. These vehicles have achieved considerably more for developing shared pathways for human capital development than simple co-location at any of our sites.

Equipment

We are comfortable with a centralised approach to large pieces of equipment (a rule of thumb could be items over $500,000). However, we feel that public research organisations require the freedom to make their own prioritisation and investment decisions within their base grant. Given the exponential increase in the power of technology, organisations need to be able to respond quickly and without an overly bureaucratic process, when trialling advances for research purposes. Total expenditure should be within a budget, with additional items, being bid for through a centralised process. Collaboration will naturally occur between organisations for smaller items where one organisation has different priorities to another – they will quickly seek partnerships with the organisations that have prioritised the items that they feel are more on the fringe of their day-to-day operation.

This already occurs, especially between universities and CRIs, with many joint purchases as well as arrangements for access to specialised equipment in exchange for co-authorship or collaboration on the project that requires the specialist equipment.

Databases and Collections

We are advocating for a different operating model to that required for the standard research functions of an organisation. We are comfortable that a national strategy (initially sitting across the existing NSDCs and then later extending to other collections and databases) should determine the priorities for digitisation and service improvement across the Databases and Collections (including digital information and service support to be available 24/7). However, the budget should be set to accommodate all reasonable costs associated with maintaining (and sequentially improving) the Databases and Collections.

Elsewhere we highlight the importance of the retention of strong connections between the research community and the Collections and Databases. This partnership ensures access to advances in technology that make core functions easier and more cost-effective to deliver. The relationship also ensures that advances in understanding may be reflected in the way data are collected or curated by a core function, and above all, ensures that data collected are continually used in research. Their on-going research use should be one of the measures by which they are evaluated on an on-going basis, alongside their use by Māori, public or commercial entities.

Physical collections will be of greatest use when physically located with researchers. However, discussions are yet to unfold with mana whenua as to how Collections and Databases can deliver more impact to our Treaty partner. Physical location and its accessibility needs to be considered within this context first and foremost. Wherever Collections and their researchers are hosted in the future, it is essential that any connected Databases sit with them and are not separated, to ensure both evolve together rather than diverge in the future.

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