Research, Science and Innovation (RSI) – Future Pathways

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Summary of Key Points

- Government funded RSIs provide a public good as of first importance.
- Commercial revenue and profits can be a useful adjunct, but are not what Government funded RSIs exist for.
- The key criteria for assessing funding bids is - Uptake + Impact + Duration = Research Efficacy.
- Need to adopt a multi-disciplinary approach to ensure the right research is being done, and research outcomes are enhanced. This should involve Te Ao Maori, Economics, International Trade, Environmental considerations, and any other relevant social sciences. Science needs to look outside itself to understand how best to achieve an impact.
- A Philosophy of Science department should be set up to scrutinise the appropriateness of research outcomes, as well as the consistency and efficacy of the scientific process.
- The company structure is not appropriate for RSIs that are expected to provide a public good and exist primarily for the benefit of all New Zealanders rather than for their own benefit.
- Infrastructure should be owned and managed by a separate entity, and leased to RSIs as required. This will improve infrastructure management, enhance flexibility and agility within the system, and help determine the opportunity cost of research.
- Funding bids still need to occur to facilitate the best initial allocation of funds. These need to be assessed based on a standard process that is impartial across organisations.
- Mechanisms should be considered for charging users who utilise and benefit from the information services provided by RSIs.

Underlying Premises

- Government funded RSIs provide a public good for the benefit of New Zealand. RSIs do not exist for their own benefit, but for the benefit of the people of New Zealand, who provide its assets and fund its operations from the resources entrusted to the Government, which are generally funded by taxes.
- This proposal has an emphasis on economic outcomes. This is because AgResearch and other CRIs are primarily funded by the Ministry of Business, Innovation and Employment. A different emphasis is likely if organisations were funded by say the Ministry for the Environment.

The Economic Benefit of RSIs

RSIs provide benefit to New Zealand when their research provides the means to harness and leverage matter and natural forces to enhance economic benefits. A general example of this is that RSIs science could provide the mechanisms for increasing harvest yields, and so increasing revenue not just for individual farmers but for all New Zealand.

For research to provide the maximum benefit for New Zealand, three dynamics need to be considered. These are: -

1. The research needs to be widely distributed. The more people applying the research, the greater the benefits will be.
2. The impact of the research. For example, if research generates a high percentage increase in yields this will be of more benefit than if the increase is relatively small.
3. The duration of the impact from Research. Research that produces a long-term increase is more beneficial than research whose benefit only accrues for a short period of time.

Therefore, the most beneficial type of research occurs when it is widely distributed to New Zealand operators, has a relatively high impact, and the benefits occur over a longer time period. These three criteria should provide the filter to measure the acceptability of Government funded research projects.

RSIs benefit New Zealand economically if the funds invested in it by the Government are less than the return it provides to New Zealand. The funds invested by Government come from two sources: -

1. Cash provided to cover operating expenses over a particular period of time.
2. The opportunity cost of assets utilised by RSIs that could generate income via some other means if RSIs was not using these assets. Examples are resources in farms and campuses, which could be utilised to provide the Government with income if they were not being utilised by RSIs.

A $1 spend by the Government at RSIs, being any mix of the above two sources, pays for itself and more then RSIs is generating economic benefit to the country. However, if a dollar spent by the Government on RSIs is not recovered then this diminishes the economic benefit.

The most obvious and direct means that RSIs can generate returns on investment is by increasing the Government's tax take. This would occur when the consequence of research is that farm profitability is improved, with the flow on effect that the beneficiary farms will then pay more tax due to increased profits. This can also have other multiplier effects, as the additional profits are likely to lead to increased expenditure in the community, leading to increased profits for third party businesses. There can also be implications for the countries balance of trade and foreign currency reserves. This is because farm produce is often

exported, and better export returns will improve the balance of trade and increase foreign currency reserves, which are then available to pay for imports.

I suggest as a rule of thumb that if $1 of expenditure at RSIs generates $3 of additional revenue to the country, then RSIs will be cost neutral to the Government. Obviously returns in excess of this would put RSIs in a position of contributing more to the Government than it costs, and so in this sense being a profitable organisation.

The Profitability Dilemma

In most organisations a profitable project is a successful project, and conversely an unprofitable project is an unsuccessful project and perhaps one that should never have been undertaken in the first place.

The above premise is not one that holds at RSIs. This is because a successful project is one that generates the greatest benefit to the overall economy, rather than simply being one that incurs fewer costs than the funds allocated for this work to be undertaken.

A simple example is that a project may have allocated to it $1m but eventually costs $1.5m. Therefore, this project is a loss-making project. However, if this project ultimately generates $9m in wider economic returns, then the Government is likely to benefit by $3m from this work (in the form of additional tax revenue etc), which is a return on investment of 100% ($3m return on an investment of $1.5m).

Alternately, a project that is allocated funds of $1m, but costs $500k has, at a project analysis level, made an ostensible profit of 100%. However, if this project generates $2m in wider economic returns, then the Government is likely to benefit by circa $700k, which is a return on investment of 40% ($700k return on expenditure of $500k).

Notwithstanding the need to efficiently produce science outcomes, the above examples demonstrate that even though a project may appear unprofitable, its eventual returns to the wider economy can more than justify incurring costs that are in excess of original funding.

In some respects, all that can be said about a profitable project is that fewer costs were incurred than funds allocated. However, it does not imply that the overall benefits from profitable projects will be greater than less profitable ones. The retort to this may be that a profitable project was overfunded in the first instance, rather than being one that has demonstrated superior efficiencies and deliverables.

A danger of placing undue emphasis on project profitability is that some beneficial work may be curtailed so that a project fulfils profitability criteria. The scope of work may be reduced to generate project profits that compromises the benefit to the wider economy.

Note that this analysis does not hold for commercial work, which is discussed below.

The Measurement Tyranny

The above discussion regarding project profitability indicates that this measure is likely to be a sub-optimal measure when considering the success of a project. The benefit to the New Zealand economy is a much better measure of determining project success when a project utilises funds provided by the Government. An inevitable challenge with determining wider economic benefits is how to measure these. This can be particularly acute if benefits are likely to be derived over a number of years and there may be a number of contingencies relating to desired outcomes.

While the issue of measuring outcomes and economic benefits will always be a challenging one, just because it is difficult should not mean that no reasonable effort is made to determine economic benefits. It also does not mean that an easy measure of success is adopted just because it is easy, as it may be measuring metrics that are not critical to best performance.

To enhance measurability, resources could be applied to this area of the organisation, which would require the likes of economists and statisticians.

Ideally, projected economic benefits from projects should form part of their funding applications.

What is being Produced and Supplied?

Although it may seem obvious, it is important for RSIs to understand what output they are generating / producing, and how this can then be utilised to achieve desired outcomes. It seems to me that the primary output of RSIs is information. Therefore, it is useful to understand how other organisations in the information industry disseminate this product into the market. For example, how do trade journals or newspapers reach their target market, while charging users for the product / service they 'consume'. Disseminating information via portals that enable consumers of information to be charged can help fund ongoing research.

While this proposal assumes that Government funded research is a public good, there is not necessarily a contradiction between providing a public good but also charging users at least a nominal cost for benefitting from the service.

Size and Capability

RSIs operations cost more to sustain than funds provided directly by the Government. This is the consequence of a choice by RSIs to operate at a capacity and capability level that enables it to undertake work that is in excess of Government requirements, and provides the platform for RSIs to undertake further commercial orientated work for often third party independent organisations.

RSIs are in a privileged position to provide research to the wider market, because Government funding has enabled them to build and sustain a resource base of world class scientists and infrastructure that any purely commercial business is unlikely to be able to acquire and

sustain. These existing resources can then be utilised to provide research services to the wider industry sector.

Some benefits of RSIs operating at a capacity that is in excess of its Government funding are as follows: -

- Provides an outlet for underutilised resources at certain times.
- Enables research capability to be build and enhanced by offering a wider variety of research options.
- Improves returns on Infrastructure assets.
- It enables economies of scale, which mean that all research initiatives can be reduced at an individual project level because the overhead costs can be spread over a larger revenue earning base.

The potential downside of having an increased operating capacity is that it needs to be funded, and therefore additional revenue needs to be generated to fund operations infrastructure and overhead that at times may be under-utilised.

Commercial Revenue

Commercial revenue is what provides RSIs with the funds to operate at a scale that is in excess of requirements for only Government funded research. Work for commercial entities allows RSIs to utilise its existing capability and capacity to provide solutions for the wider commercial market. Work for commercial entities is likely to have some different characteristics to work that is undertaken to provide a public good and is funded by the Government. Some of these differences are suggested to be as follows:

- Rights to the outcomes of the research are likely to reside with the entity that is paying for the work, and therefore may not be able to be distributed more widely by RSIs.
- Work undertaken for commercial purposes should have a greater emphasis on producing a profit. Commercial work provides RSIs with an opportunity to supplement the income it receives from the Government. If commercial work is not profitable at a project level, then it is questionable whether this work should be undertaken. Note that this criteria is less applicable for Government funded work whose output becomes a public good.
- The criteria for the acceptance or rejection of commercial work may oscillate depending on what other resource constraints the organisation is subject to at that time. For example, if there is a lull in staff utilisation due to a lack of funding from other sources, then commercial work may be more readily accepted than during times when staff are fully utilised.
- Factored into a profitability analysis for commercial work needs to be a return on investment. This is because commercial work will benefit from the infrastructure that RSIs holds, whereas Government funded work is utilising assets provided by the Government for the wider purpose of providing a public good.

- Commercial work should never be subsidised by Government funding. An unacceptable practice is for time worked on a commercial venture to be attributed to Government funded work. This is because Government funding is then being applied to commercial work for the benefit of a commercial third party, or it could be said that Government funding is being diverted into commercial work and away from its intended purpose of providing a public good for New Zealand that enhances the country's prosperity. There should always be a clear demarcation between Government funded projects and commercially funded projects. There can be a temptation to shift resources provided by the Government across to commercial work, as commercial projects can be more rigorous in their requirements and be operating to tight margins. However, moving resources provided by the Government for other purposes is nothing less than the misappropriation of public funds and this is a practice RSIs must not be involved with.

While commercial revenue may have a place within the RSI structure, it is not the main purpose of RSIs. If commercial performance was the primary driver for RSIs, it is questionable whether the government would choose to continue RSIs, or if resources would be better diverted into other spheres of business and society.

Company Profitability

As discussed above, individual project profitability is not necessarily the best measure of project success. This principle follows through at a company-wide level, where company profitability is not the only and necessarily best measure of company performance. As stated earlier, as government funded and owned organisations, RSIs do not exist for their own benefit. Profitability is generally a measure of success because it indicates that the company and its immediate owners are acquiring benefit from the company's operations. RSIs and other similar organisations exist to benefit wider society, and therefore the drive for profitability is subordinated to other priorities.

The concept of RSIs returning profits to the Government in the form of a dividend is a misnomer. This is because the payment of a dividend represents a return of funding to the same source that it came from, and is a tacit admission that the Government probably has better things to do with its money than spend it at RSIs. In contrast, RSIs should work from the premise that Government funding provided to its business will always be appropriately invested to the benefit of the country. Therefore, rather than returning any money to the Government RSIs should back themselves to spend these funds for the greater good. It would also be a contradiction for RSIs to return funds to the Government with one hand via a dividend while simultaneously lobbying for additional Government funding. This scenario would be worsened if the lobbying mechanism itself consumed additional resources.

Profits derived to provide funding for future research maintains RSIs's integrity as a provider of public welfare. However, it also raises some questions as follows: -

- Is RSIs anticipating a future fall in Government funding that it is seeking to mitigate?

- Generally, a dollar spent on public good today will produce a better long-term benefit than a dollar spent at some future date. There is an expectation of an exponential benefit from money spent on a public good.
- Will a reduction in spending now to generate profits create variability in resource requirements over the long-term i.e. fewer resources will be required during profitable years, while more resources will be required when previously accrued retained earnings are utilised? Resource utilisation requirements can generate their own costs, such as employee recruitment costs.
- Are RSIs anticipating an oscillating approach to Government funding, which is mitigated by profits being retained during some years to smooth ongoing expenditure when it is released in other years.

Because RSIs receive Government funding that is not based on the production of a specific product or service, the pathway to profitability is arguably a relatively straight forward one by merely reducing expenditure, and consequently the amount of resources applied and available, to a point where funds received is greater than costs incurred. However, this approach seems to contradict RSIs's purpose, which is to utilise available funding to enhance benefits to the country. Again, it is mentioned that retaining or returning profits while simultaneously lobbying the Government for more funding appears to create contradictory agendas.

What about Projects whose purpose is 'not' of an economic nature?

The primary sector is facing ongoing and escalating challenges relating to climate change, other environmental concerns, sustainability, and ethical agriculture.

Like any business proposition, RSIs operate in a business environment subject to a number of resource constraints. Perhaps the most obvious example of this is the amount of available land for agricultural enterprises (land is a fixed commodity). Concerns and requirements relating to the environment are impacting and altering the constraints that the primary sector has historically been confronted with. These additional constraints may have the impact of reducing the volume of agricultural output, and / or also of increasing the cost of agricultural output.

A shift in and increase in constraints challenges the capacity of the industry to be profitable. Businesses operating on the margin may find that these constraints move a marginally profitable operation into an unprofitable and therefore unsustainable position.

The industry has three options when dealing with an increase in constraints imposed on it: -

1. Absorb any adverse economic and business consequences of operating within a constraint.
2. Challenge the constraint, which may involve lobbying at existing law makers. Environmental restraints will often involve a level of discretion.
3. Initiate innovative operating practices that enable businesses to fulfil the constraint but to do so in a manner that minimises economic and business deterioration.

It is the third of the above three alternatives where MBIE funded RSIs's contribution could be particularly pronounced. However, RSIs's skills could be engaged at all three options.

Infrastructure

One of the main strategic enablers to providing good Research is Infrastructure. This generally comprises of Land, Building, Plant and Equipment, and Technology. Infrastructure is generally the most expensive asset held by RSI's. Because Infrastructure is a high value asset, it also incurs opportunity costs. Capital tied up in RSI infrastructure means that this capital cannot be utilised in an alternative venture, which means that any benefits from the alternative use of this capital cannot be realised. As the provider of a public good, opportunity cost incurred will not necessarily mean that resources are diverted into a better paying investment. However, recognising the opportunity cost of infrastructure holdings should also be factored into investment decisions and any analysis of organisation viability. RSIs that hold substantial debt free assets are much more likely to generate an accounting profit than those that need to lease infrastructure. However, the opportunity cost of holding assets for RSI purposes will be much higher for organisation that own their assets, and this cost should be factored into any analysis.

There are advantages and disadvantages of organisations holding owning their assets. In my view the disadvantages significantly outweigh the advantages.

Some advantages are as follows: -

- Organisations can apply the assets as they choose, and so can take a long-term view on how best utilise those assets.
- Assets that are owned can be disposed of and replaced as required to adjustment to the strategic direction of the organisation.
- Assets can be liquidated to cover any shortfall in revenue or cost overruns.

Some disadvantages are as follows: -

- Infrastructure held by separate organisations requires each organisation to have its own infrastructure management systems and processes.
- Infrastructure underutilised by one organisation may not be available for use by another organisation.
- RSIs do not have the expertise to provide good quality asset and facilities management.
- Ownership of infrastructure spread across a number of RSI's does not consistently recognise the opportunity cost of holding infrastructure.

My suggestion is that RSI core infrastructure is owned and managed by an asset management entity. This would centralise asset management into an entity with the expertise required to management a large property portfolio. It would require RSIs to lease property from this

holding entity, which would have the effect of determining the opportunity cost of science work. By centralising property ownership into the hands of one entity, it would mitigate the likelihood that asset transactions occur that benefit the individual organisation, but are suboptimal from an overall Government owned RSI perspective. An asset management organisation would also be better placed to deal with assets that are currently not required. This could include leasing assets to third parties for commercial gain, or retiring assets and utilising the funds to improve or add to existing infrastructure.

Plant and equipment related to specific science work undertaken by RSI entities should continue to be owned and maintained by those entities, as the specialised nature of some of these resources means that they are better maintained by the operators.

Bidding for Funds

Funding applications have the potential to incur significant costs as people compile proposals in an effort to access limited funds. The consistent need to compete for funds ties up resources in activities for which there may be no beneficial outcomes.

However, bidding within and across RSIs can be positive in helping to allocate resources into areas that will have the greatest benefit for the country. It seems appropriate to have some level of scrutiny and understanding of potential outcomes before research projects are embarked upon. Therefore, some level of competitive bidding is appropriate in the process of seeking to allocate funds in the most efficacious way. The important consideration is how this competitive bidding process is undertaken to ensure that the benefits exceed the costs.

I suggest a reasonably robust criteria based on a set criteria that focuses on potential outcomes and how they will add value to the prosperity of New Zealand.

The assessment of bids should be aligned with the following criteria: -

1. The research needs to be widely distributed. The more people applying the research, the greater the benefits will be.
2. The impact of the research. For example, if research generates a high percentage increase in yields this will be of more benefit than if the increase is relatively small.
3. The duration of the impact from Research. Research that produces a long-term increase is more beneficial than research whose benefit only accrues for a short period of time.

Multi-Disciplinary Research

Research needs to be informed by other disciplines and social sciences to ensure that it is accomplishing the right goals. This is likely to include, but not be limited to, economics, international trade, Te Ao Maori, and marketing. When research is blended with other

disciplines, which could form part of research, then direction and guidance is provided to enhance optimal outcomes.

Philosophy of Science

A Philosophy of Science department will help to provide the RSIs with an anchor to keep them grounded in rational processes and meaningful outcomes – to contribute to the greater good. A Philosophy of Science Department could provide guidance to science in the following areas:

- Conceptual clarification.
- Critique of scientific assumptions.
- A rational / logical framework.
- Identify intrinsic biases.
- Provide direction and the why of purpose.
- As science becomes increasingly specialised, philosophy can be the galvanising influence that brings consistency of approach to increasingly disparate scientific disciplines.

I suggest a cross RSI Philosophy of Science department is established for the above mentioned reasons.

CRI Review Questions

1. What principles could be used to determine the scope and focus of research priorities?

An important first step is to consider whether research conducted in Government owned organisations is undertaken for commercial purposes or to provide a public good. My underlying premise is that Government owned research organisations, such as CRIs, exist for the purpose of providing a public good for the benefit of all New Zealanders. Commercial endeavours may at times provide a useful adjunct to public good research, but government owned RSI organisations must prioritise providing a public good. The provision of public goods that will benefit all New Zealanders environmentally, economically, and socially is the first principle for determining the scope and focus of research priorities.

Research organisations partner with the primary and manufacturing sectors to drive prosperity and economic growth, with the implication that social outcomes are enhanced by improved prosperity.

For research to provide the maximum benefit for New Zealand, three principles need to be considered. These are: -

4. Research uptake. The more organisations / people applying the research, the greater the benefits will be.

5. The research needs to have a high impact. For example, if research generates a high percentage increase in yields this will be of more benefit than if the increase is relatively small.
6. The duration of the impact from Research. Research whose benefit occurs over a long period of time will be more beneficial than research whose benefit only accrues for a short period of time.

Uptake + Impact + Duration = Research Efficacy.

Research focus needs to be on facilitating prosperity. The above three maxims / principles should be considered when determining what research to focus on and the scope of that research. When the cost of research exceeds the benefits from increases in prosperity, then the research should not be undertaken – it falls out of scope.

Research should also assist business to navigate current and evolving constraints that exist to ensure beneficial environmental and social outcomes. These constraints often indicate that the means to the end is also relevant. For example, environmental considerations are imposing increasing restraints on rural businesses. Operating within the confines of these constraints is an important aspect of operating a business in the modern environment.

2.What principles should guide a national research priority-setting process and how can the process best give effect to Te Tiriti?

This seems to be asking the same question as the one above, with the addition of the subordinate clause in this section relating to giving best effect to Te Tiriti. Priority should be given to projects that fall within the focus and scope of research. The maxims to determine this are given in question 1.

3.How should the strategy for each research priority be set and how do we operationalise them?

Strategy should be outcome focused. Any work should be assessed against its capacity to achieve outcomes. Only projects that lead to required outcomes should be undertaken. The operationalisation of research priorities needs to sit with the managers of business units and organisations.

4.How would you like to be engaged throughout the Future Pathways programme?

Responses to individual submissions would be appreciated.

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

Matauranga Maori provides a framework and worldview within which research can be applied. It provides a useful framework for directing what research is undertaken, how it is

undertaken, and how it is applied. It also encourages research to provide a holistic view of its impact on different facets of human endeavour such as the environment and economic impacts.

6.What are your thoughts on regionally based Māori knowledge hubs?

I suggest Research directed at a specific region is not the norm, but the application of research could have a regional bias at the discretion of leaders within that area.

There may be occasions when regional based research is requested, but this is likely to be an exception rather than the norm. I suggest nationwide research that can be applied contextually as required.

7.How should we determine what constitutes a core function and how do we fund them?

Determining what constitutes a core function will involve a level of discretion, and it is likely that there will be differences of opinion. Categorising core functions will help to determine which ones should be funded. For example, categories such as essential, beneficial, useful, could be applied to determine which core functions should be funded.

Core functions are likely to complement other research related activities, and can also draw on the same talent pool that is domiciled within a Research Institution. Therefore, the resources required to undertake core functions will often be most readily available within research organisations. This suggests that core functions should remain within an overall research organisation that has the best mix of resources to support the core function.

Core functions will come from a range of research disciplines and will need to be independently identified and verified, as different institutions will have differing views on what is a priority core function. However, the performance of core functions should remain within specialised research institutes, which have the existing capability to undertake these functions. This will ensure the benefits of economies of scale and specialisation are maximised.

Funding relating to core functions needs to be specifically applied to the function concerned, and not assimilated into the wider expenditure pool. To achieve this, specific accounts will need to be kept of work relating to core functions. To enhance accountability, intermittent audits could be carried out.

To sum, core functions should be housed within the research institution best equipped to meet the functions needs, financial accountability of core function funding and its application is required, and funding decisions need to be made independently with the purpose of allocating resources to core functions that have the greatest benefit to the country.

8.Do you think a base grant funding model will improve stability and resilience for organisations? How should we go about designing and implementing such a funding model?

If there are a number of disparate RSI institutions, then the provision of a base grant across a number of organisations will be more difficult to administer and manage. This is partly because desired funding across individual organisations is likely to be more variable than funding for the sector as a whole. Therefore, if a model of having a number of small institutions under the RSI umbrella is pursued, a base grant funding model may be very difficult to maintain. Alternately, institution consolidation and / or the use of shared services across a number of RSI institutions lends itself more readily to a base grant funding model.

The utilisation of a base grant is likely to create a trade-off between stability and flexibility. A grant to cover underlying costs will assist long term stability. However, it will reduce a funders ability to be agile and adjust priorities at short notice. Therefore, a base grant funding model versus an overhead component added to research funding are models of operating that will move the balance between stability and flexibility. While a base grant can be adjusted over time, the speed of any change is likely to inhibit organisation and research agility.

Stability in research institutions is vital to ensure an engaged and harmonious workforce. When Personnel find their job security is contingent on the vagaries of the next funding round, then this is can have an adverse impact on their capacity to plan long term, their mental resilience, and job satisfaction. Therefore, a base grant would have the effect of enhancing stability and resilience. A base funding model is more conducive to status quo research and a desire to enhance stability.

If a base grant funding model is used, accounts would need to be keep of spending within designated functions so that funds provided for daily operations were not inadvertently diverted into research, and vice versa. Therefore, a greater emphasis on financial accountability would be required.

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

Organisations that are able to focus on research rather than a plethora of peripheral activities such as funding bids, financial management, and infrastructure management are more likely to be collaborative, adaptive and agile. Therefore, the design and expectations of research organisations is fundamental in creating collaborative, adaptive, and agile research institutions.

RSI institutes do not exist for their own benefit, but for the benefit of the people of New Zealand, who provide its assets and fund its operations from the resources entrusted to the Government, which are generally funded by taxes. Therefore, the company operating model seems inconsistent with organisations designed to provide a public good. It is not possible for RSIs to simultaneously serve the agendas of creating value for themselves and generating value for all New Zealand, as this will create a confusion of priorities. On many occasions,

projects that maximise the benefit for the individual institute will not maximise the benefit to all of New Zealand, so the current company ownership structure gives conflicting messages.

Core infrastructure that is generic across RSIs should be managed by an infrastructure management organisation, rather than being owned by individual institutions. Facilities could be leased as required by RSIs from the government owned infrastructure management organisation. This will allow research organisations more flexibility in adjusting size and scope, and remove some of the burden of dealing with large infrastructure holdings that are outside its core business. Other core services could also be centralised to enable research institutes to be more adaptive and agile. Examples of these services are finance, human resources, and IT.

It seems likely that there is no one best size organisation for all sectors of the New Zealand research capability. What is important is to provide a structure that builds flexibility into the research organisations that do exist so that future change can be relatively seamless.

10.How can institutions be designed to better support capability, skills and workforce development?

Researchers may seek to future proof their careers by acquiring a range of capabilities. However, a consequence of this approach is that specialisation in niche areas can be lost. Therefore, it is important that people entering desired specialisations are given job security, and able to enhance their specialisation and plan for the long term. To achieve this, a wholistic approach to research needs to be maintained that goes beyond the whims of short term decision making or funding regimes.

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

As mentioned in my response to question 9, infrastructure should be owned and managed by a separate entity that provides necessary facilities to research as required. This infrastructure management entity, in consultation with the RSIs, would be responsible for property and capital investments. By centralising infrastructure management within one entity, all RSIs would be able to call on a pool of assets as these were available, which would enhance utilisation and coordination.

12.How do we design Te Tiriti enabled institutions?

Te Ao Maori applies an integrated approach that acknowledges interconnectedness and interrelationships. To facilitate this world view, RSIs need to provide institutions that consider the wholistic outcomes of research and the peripheral impacts that the application of the research is likely to incur.

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

Impact can only occur if research findings are disseminated to people and organisations that can apply these findings to enhance outcomes. Therefore, the mode and reach of research findings is important. To achieve this, beneficiaries of the research need to be identified, and information needs to be provided to them in a format that they can readily understand and apply. To this end, good communications are required and should be part of the overall research process.

17.How do we support sustainable, efficient and enabling investment in research infrastructure?

One of the main strategic enablers to providing good Research is Infrastructure. This generally comprises of Land, Building, Plant and Equipment, and Technology (including data repositories and data science applications) . Infrastructure is generally the most expensive asset held by RSI's. Because Infrastructure is a high value asset, it also incurs opportunity costs. Capital tied up in RSI infrastructure means that this capital cannot be utilised in an alternative venture, which means that any benefits from the alternative use of this capital cannot be realised. As the provider of a public good, opportunity cost incurred will not necessarily mean that resources are diverted into a better paying investment. However, recognising the opportunity cost of infrastructure holdings should also be factored into investment decisions and any analysis of organisation viability. RSIs that hold substantial debt free assets are much more likely to generate an accounting profit than those that need to lease infrastructure. However, the opportunity cost of holding assets for RSI purposes will be much higher for organisation that own their assets, and this cost should be factored into any analysis.

There are advantages and disadvantages of organisations holding owning their assets. In my view the disadvantages significantly outweigh the advantages.

Some advantages are as follows: -

- Organisations can apply the assets as they choose, and so can take a long-term view on how best utilise those assets.
- Assets that are owned can be disposed of and replaced as required to adjustment to the strategic direction of the organisation.
- Assets can be liquidated to cover any shortfall in revenue or cost overruns.

Some disadvantages are as follows: -

- Infrastructure held by separate organisations requires each organisation to have its own infrastructure management team, systems, and processes.

- Infrastructure underutilised by one organisation may not be available for use by another organisation.
- RSIs do not have the individual expertise to provide good quality asset and facilities management.
- Ownership of infrastructure spread across a number of RSI's does not consistently recognise the opportunity cost of holding infrastructure.

My suggestion is that RSI core infrastructure (not including data science repositories) is owned and managed by an asset management entity. This would centralise asset management into an entity with the expertise required to manage a large property and plant portfolio. It would require RSIs to lease property from this holding entity, which would have the effect of determining the opportunity cost of science work. By centralising property ownership into the hands of one entity, it would mitigate the likelihood that asset transactions occur that benefit the individual organisation, but are suboptimal from an overall Government owned RSIs perspective. An asset management organisation would also be better placed to deal with assets that are currently not required. This could include leasing assets to third parties for commercial gain, or retiring assets and utilising the funds to improve or add to existing infrastructure.

Plant and equipment related to specific science work undertaken by RSI entities should continue to be owned and maintained by those entities, as the specialised nature of these resources means that they are better maintained by the operators.