MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Impact of science discussion paper

Summary of submissions

New Zealand Government

Contents

Executive summary

The demonstration and measurement of the impact of science is receiving increasing attention internationally and in New Zealand. To improve understanding of the concept of impact in relation to science investment, the Ministry of Business, Innovation and Employment (MBIE) sought feedback on a discussion paper that aimed to stimulate conversation among individuals, sectors and communities.

This document summarises the responses made in the 59 submissions received from research organisations, tertiary education organisations, sector and funding organisations, government agencies, the business sector, other organisations and individuals. The few significant differences observed between sectors have been noted.

Overall themes

- Almost all submitters welcomed the paper, even if they were critical of certain aspects. Most submitters thought it important to consider the impact of science and research in the context of policy and investment decisions, but this support was often qualified.
- The scope of the discussion paper was thought to need clarification, in particular whether it covered only science or all fields of research.
- Many submissions emphasised that end-users and other stakeholders had an important role in determining the impact of science and that accountabilities ought to reflect the various roles.

The definition of impact

- More than half of submitters did not have a view on whether the definition of impact used within New Zealand should be aligned with international usage but, of those who did, most supported international alignment, particularly with that of the OECD. There was a general desire for definitions to be clearly articulated and consistently used.
- Many submitters said that seeking to measure final results would not be possible because of the long time periods involved, and because what seems final at one stage might later be regarded as an intermediate step to a further, final result.
- There was a strong call to continue to measure intermediate results, and reflect more on the interim stages of impact. This was partly because of the difficulties of measuring the long-term impacts. Many submitters supported valuing and measuring academic impact and development of human capital.

Impact categorisation frameworks

- No single categorisation framework received clear support from submitters.
- There was about the same level of support for the Treasury Higher Living Standards framework – usually with some qualification or suggestion for adjustment – as against the framework.

Generic results chain

- Many submissions supported the use of the generic results chain model but often with significant qualifications, in particular, that its linear approach was too simplistic and did not portray the networked nature of science.

Worked examples

- Many submissions supported the use of the worked examples in the discussion paper, but often with significant qualifications. The examples were often thought to be too linear and simplistic, and missing the complexity of multiple pathways and feedback loops that exist in the science system.

Mechanisms and processes

- Submissions reflected the complexity of the topic as outlined in the discussion paper. Submitters highlighted the absence of clear definitions for impact and outcomes, challenges of long lags, the uncertain nature of science, and the appropriate unit of analysis for assessment.
- An issue often raised was the importance of identifying and supporting mechanisms for enhancing dissemination, uptake and adoption of research, such as open access.

Implementing an impact agenda

- Submitters cautioned against seeking a 'balance' between ex-ante and ex-post evaluation, as these are distinct undertakings done for different purposes.
- The lack of an evidential basis for ex-ante evaluation was highlighted by a number of submitters, as was the tension between demonstrating impact while retaining opportunities for 'blue skies' research.
- Many submitters recognised the difficulty of conducting ex-post evaluation, but almost all who commented on this point either expressed a desire for more ex-post evaluation or made suggestions for how it might be improved.
- Some submitters pointed out that increased impact measurement would impose a potentially significant cost, and suggested that the burden of evaluation should not fall exclusively on researchers.

1 Introduction

1.1 Background to the discussion paper

The demonstration and measurement of impact is receiving increasing attention internationally and in New Zealand.

To improve understanding of the concept of impact in relation to science investment, MBIE sought feedback on a discussion paper in mid-2017[1].

The paper discussed the concept of impact as it relates to the science system. It set out why impact is important, what impact is, what it looks like, and how and where impact is generated. It also discussed the implications of the impact pillar for the science system. The summary of the discussion paper is reproduced in section 1.3 below.

1.2 Purpose of discussion paper and next steps

The purpose of the discussion paper was to stimulate conversation and dialogue among researchers, scientists, government, industry and communities that have an interest in better understanding the impacts of science.

Feedback on the paper will be used to inform the development of a policy paper on the place of impact in the government's investment in science. The paper is expected to inform policies, investment processes and evaluation frameworks.

MBIE will be holding further discussion with the sector over the next few months. Please send an email to scienceimpact@mbie.govt.nz if you would like to participate in further dialogue.

1.3 Summary of discussion paper[2]

The importance of identifying the impacts of public investment in science

Researchers, scientists, governments, industry and communities all have an interest in better understanding the impacts of science. Scientists wish to demonstrate the benefits of their work, while governments, industry and communities wish to gain value from new knowledge.

Governments around the world are increasingly demanding that public investments in science demonstrate tangible impacts. As major investors in science, governments must be able to show the value of science funding to the public. Science is expected to make contributions towards explicit societal goals and advance development. An inability to demonstrate impact can jeopardise support for public investments in science over the long term.

New Zealand is no exception to this international trend. The National Statement of Science Investment 2015–2025 (NSSI) set impact as one of two pillars of the science system. The vision of the NSSI provided the clear expectation that government investments in science make measurable contributions to productivity and the wellbeing of New Zealanders. To do this, the science system needs a collective understanding of impact and an appreciation of the issues involved in generating and demonstrating impact.

[1] The impact of science; discussion paper: http://www.mbie.govt.nz/info-services/science-innovation/national-statement-science-investment/science-impact-discussion-paper-june-2017.pdf

Impact is the final, long-term effect in a causal results chain

Impact is part of results-based management and is critical to demonstrating value for money. The 'pathway to impact' is a concept that maps out the causal sequences in a 'results chain', linking the inputs, factors and actors involved in generating outcomes. Impact is the end of the causal chain, representing the final and long-term effects.

Policymakers use the word impact broadly to refer to effects on individuals, groups and society. This is different from the academic use of the word, which refers to the use of knowledge by other academics. The paper suggested that academic impact be integrated into the results chain as a step before broader societal impacts. Doing so would recognise that excellent science delivering academic impact is an important step along this pathway.

A generic results chain for science

The New Zealand public sector use of the terms outcomes and impacts differs from that widely used across the OECD and the standard results chain model. New Zealand uses outcomes to refer to the final results, ie, the final step in the chain. This can lead to some confusion in the science system, particularly given that many New Zealand scientists collaborate with scientists around the world who are working in funding systems that use impacts to refer to the end result. A closer alignment with the OECD results chain model and associated definitions would provide needed clarity.

The paper put forward a generic results chain model for science:

- *Inputs*: stock of knowledge, people, funding, infrastructure and facilities
- *Activities*: interactive process of generating knowledge and training others
- *Outputs*: publications, products and intellectual property (IP) that codify knowledge; tacit knowledge exchanged between collaborators; students and postgraduate researchers trained
- *Outcomes*: filling of knowledge gaps; use of knowledge by other researchers, government, industry and organisations; increases in economic, natural, social and human capital
- *Impacts*: increases in productivity and wellbeing.

Properties of knowledge and science make impact assessment challenging

Science is by its nature about discovery, generating new knowledge and applying knowledge. Whole networks of scientists and collaborators generate knowledge, making it challenging to establish inputs and attribution. This is especially the case for a small country like New Zealand.

It is inherently difficult to identify the potential uses of science up front — history tells us we are poor at predicting the use of knowledge. It can take many years for new knowledge to be widely used and applied in various settings, and these uses are often difficult to monitor and track. Complementary inventions and technology are sometimes needed before the full benefits of particular knowledge can be used, creating lags in full impact generation. In other cases, society may not be ready to adopt the knowledge; financial, regulatory, social and other barriers may prevent uptake.

Science contributes to a wide range of impacts. Generating these impacts requires engagement of other actors and institutions. Untangling the effect of the science and research

is often very challenging. Further, it is difficult to quantify many impacts, such as social and environmental impacts.

Implementation of the impact pillar across the science system

The concept of impact needs to be embedded fully across the New Zealand science system. This may require changes to policies, investment processes and evaluation. For the impact pillar to be implemented effectively, the following is required:

- Conceptual clarity on the generic results chain with clear distinction between outputs, outcomes and impact.
- Focus on the mechanisms and processes to generate impacts (ie, pathways to impact) — such as knowledge exchange, collaboration with end users, and improvements in public policy and human capital — given the difficulties in identifying the contribution science has made to impacts.
- Clearer understanding of the geographic, sectoral and social distribution of impacts, given its importance to the rationale for government investment.
- Further information on the value New Zealanders place on various impacts.
- Widespread use of credible pathways to impact in ex-ante and ex-post processes (assessment of funding applications is an ex-ante process; assessment of results following completion of the science is an ex-post process).
- A much greater emphasis on ex-post evaluation to demonstrate actual impacts, to better understand pathways to impact, and to inform ex-ante assessment.
- Development of an ex-post evaluation framework that includes measurement principles and that is underpinned by robust data and information.
- Creation of an evidence base drawing on data, information, analytics, and studies on science that show how science has contributed to various impacts.

2 Consultation on the discussion paper

2.1 Consultation process

MBIE published the discussion on its website on 26 June 2017. All MBIE's science and innovation subscribers, numbering almost 5,000 and including research/science and end-user organisations, were notified by email.

MBIE sought feedback on the discussion paper by the end of September 2017 and received 59 written submissions. Several submitters discussed the paper with MBIE before making their submissions. No consultation form was provided, nor was guidance given on the balance sought between response to discussion points and input on other related matters.

2.2 Who provided feedback

The 59 written submissions received were categorised into seven groups, as shown in the following table.

Category of submitter	Sub-categories	Number of submissions
Research organisations	• Crown research institutes (CRIs) • Independent research organisations (IROs) • Representative bodies for research organisations (Science New Zealand and IRANZ)	14
Tertiary education organisations	• Universities • Institutes of technology and polytechnics • Centres of research excellence (COREs)	12
Sector and funding organisations	• Royal Society Te Apārangi • Funding bodies (Marsden Council and the Health Research Council)	3
Government	• Central government departments • Ministerial advisory committee (Office of the Prime Minister's Chief Science Advisor) • Local government and relevant representative organisations	4
Business sector	• Industry representative organisations • Businesses	5
Other organisations	• Not-for-profit representative organisations • Organisations not otherwise categorised	8
Individuals		13

Notes

Appendix 1 lists submissions by category, and indicates which subcategory they were placed in.

One submission in the individual category was made by 45 Rutherford Discovery Fellowship recipients.

The individual category includes submissions sent from a company or institutional email address, but which were either identified as being made in a personal capacity or not identified as being the view of that entity.

There were four submissions from overseas: two businesses, one individual and one other organisation.

2.3 Approach to summarising submissions

MBIE allocated each submission a unique number to enable easy identification during the analysis process. Information contained in the submissions was extracted and sorted by topic area corresponding to the discussion points and areas covered in the document, and key points were recorded for use in this summary of submissions.

More than two-thirds of submitters directly addressed all or most of the discussion questions, and most provided additional commentary that, in some cases, was quite detailed.

The aim of this document is to summarise the information and ideas contained in the submissions in a clear and concise way. The summary is based on a broad review of the content of the submissions received. It identifies major themes and common responses to the questions raised in the consultation document. Where sectoral differences are apparent, these have been noted.

Emphasis has been placed on the range of views presented and the comments supporting these views, rather than on the numbers advocating a particular position. Counting would be difficult as some of the submissions represent a single voice, while others carry the formal mandate of an institution and/or many individuals. The diversity of responses also makes counting difficult. For example, some submitters commented on only one specific aspect of an issue, or may have supported some points while disagreeing with others. An indication of the level of support for various positions is useful, so this summary uses everyday language such as 'a few', 'some', 'many', 'most' and 'almost all' to convey in general terms how widely held a particular position might be.

The report also notes comments made in the submissions relating to any parts of the consultation document where no specific questions were asked, or comments made more generally around the concept of impact of science.

Selected quotes and examples from submissions have been included (in italics) for their value in illustrating points made by submitters. Where quotes from submissions are used, any unexplained acronyms or minor typological errors have been amended to improve readability. The use of quotes from some submissions does not imply that these have been given more weight than submissions that have not been cited.

The submissions provide an insight into how science investment is viewed by several sectors of society. This summary does not provide an in-depth analysis of individual submissions; however, it does reflect the main themes and points of view expressed in the submissions. Not many differences were observed in the responses made by different sectors, but any that were apparent have been noted in the summary.

3 Overall themes

3.1 General response to paper

Almost all submitters welcomed that MBIE was discussing the subject of impact with the research sector, with the aim of reaching an understanding about impact and ultimately increasing research impact — even if they were critical of aspects of the paper.

> *The discussion paper is a very competent and valuable assessment of issues surrounding the impact of New Zealand science. It brings together for the first time various dimensions of impact evaluation as they relate to the New Zealand experience, creating an important enduring resource.*

> *This is an important document, and I applaud MBIE for a careful and comprehensive analysis of these important questions. I agree that government and science stakeholders must focus attention on characterisation and measurement of science impacts.*

Many submitters urged MBIE to continue consideration of the subject through dialogue with interested parties.

> *We applaud the Ministry for consulting with the sector from this early stage, and look forward to continuing to work with the Ministry as an approach is developed.*

> *We recommend a series of further reflections, particularly on definitions and how they can be viably operationalised, development of the impact community to embed impact within the New Zealand research sector, and purposeful articulation of non-economic benefits.*

3.2 Scope

The scope of the paper was questioned: whether its discussion of impact covered only science or all fields of research. Several submitters pointed out the lack of consistent terminology in the paper, leading to uncertainty on this point. They recommended that the scope of the discussion should include humanities, arts, social sciences (HASS) as well as science, technology, engineering and maths (STEM) disciplines. These submitters considered science only as too restrictive. One submission from a university considered the discussion should cover only publicly-funded science or research.

3.3 Why impact

Most submitters regarded it as important for the impact of science/research to be considered in the context of policy and investment decisions:

- As most research in New Zealand is government-funded, taxpayers have a right to know what is being done with their money, so having impact as an NSSI pillar is entirely justified.
- There is not enough emphasis in the New Zealand science/research system on work aimed at increasing impact.

We agree with the need to demonstrate value from the government's investment in science beyond academic achievements.

In many cases this support was quite nuanced:

- New Zealand needs a culture of making impact, not simply measuring impact. There is a need to identify impact enablers, identify (including from proven methods used overseas) tools and methods to enhance impact culture, and resource this appropriately.
- It is unwise to attempt to measure impact at the level of the individual project, programme or researcher. There is value in considering this at the level of institution, fund or even research area (eg, cancer research).
- Measuring adoption, including impact generation, will improve assessment of factors driving impact, but care is needed not to stifle long-term (and hard-to-measure) benefits.
- It is valid for the public/government to measure the economic stimulation of innovation, but framing the knowledge base as an economic commodity undermines the notion of measuring impact by limiting it to traditional indicators.
- Benefit to New Zealand is emphasised in the document, but this has limitations. In the past this has related to industries already established here rather than those not already established, even though these might have more transformative potential. New Zealand needs to contribute to the global research endeavour.
- It would be useful to have more explanation of how international studies referenced on page 8 are relevant to New Zealand.

A few submissions were not supportive of an increased focus on impact assessment:

- There is no evidence that an increasing emphasis on measuring impact has resulted in greater impact.
- The discussion paper contradicts the NSSI by asserting that all investments should be able to demonstrate actual pathways to impact, whereas the NSSI supports high-risk research.
- It is inevitably easier to demonstrate impact in particular areas of research, but it does not follow that work in these areas is of particularly high value for New Zealand. Impact assessment may channel research towards less significant and certainly less ambitious areas.
- Instead of investing in impact measurement, why not just acknowledge that scientific research is generally useful, and use that money to fund more of it?
- Caution against basic science being undervalued by a greater focus on measuring impact. One possible solution would be to make a separate allocation for basic research and use impact assessment for prioritising other research.

A focus on supporting only impactful research (by whatever measures) will almost certainly have significant negative consequences for New Zealand.

… by far the most important issue to emerge from this paper is an apparent shift towards tying New Zealand's research funding to assessment of research impact. It is not at all clear to us that the rationales this paper provides for impact assessment actually align with benefits for New Zealand. Any useful methods for assessing impact must fully account for the difficulties,

uncertainties and subjectivity of assessment, and the costs, including the use of researchers' time and opportunity cost for MBIE.
We see more value in directing resources towards improving standards of assessment, supporting researchers and their work, and building trust within the research funding system.

3.4 Role of end-users and other stakeholders

Many submissions addressed the questions of responsibility and accountability, making the point that the closer an assessment is to 'impact', the less control researchers have. Different models were presented to show this, but a frequent comment was that end-users and other stakeholders have much more influence than researchers over uptake and thus impact. This is discussed more in section 8 below.

There is a critical need to recognise and act on the key issues of responsibility and accountability of all organisations involved in the impact pathway. For example, at the most basic level, funding agencies are responsible for making decisions on resource allocation, and so are accountable for their decisions; research organisations are responsible for delivering contracted science, and so are accountable for their delivery, and uptake by, stakeholders; stakeholder/end-users are responsible for making decisions on what actions and activities will result in the achievement of the desired impacts, and so are accountable for the achievements of the impacts.

It was also frequently suggested that the government should encourage and fund activities that increase dissemination, stakeholder engagement and ultimately impact, using methods proven internationally. Some submitters favoured mandating open-access dissemination of research results, though one contrary view was expressed.

The point was also made that impact can be enhanced by considering end-user and stakeholder needs before committing investment.

… the government is failing to realise the full benefit of its science investment across the board by not adequately considering broader engagement, including to the public, in its various research funding mechanisms.

… the social licence crucial to enabling scientists to do their work involves early and continuous engagement of the science community with society at all levels and in all areas.

4 What does impact mean?

Discussion points: While the focus needs to be on the pathway to impact, the definition of impact still matters. Should the NSSI definition of impact be made clearer to refer only to final results, long-term results or both? What are the reasons for your view? Note focusing only on final results would mean excluding improvements in human capital and academic impact as impacts, but these concepts would clearly form part of the results chain, ie, part of the pathway to impact.

More than half of submitters did not have a view on whether the definition of impact used within New Zealand science and research policy should be aligned with international usage but, of those who did, most supported international alignment, particularly with that of the OECD. There was a general desire for definitions to be clearly articulated and consistently used. Many submitters said that seeking to measure final results would not be possible because of the long time periods involved, and because what seems final at one stage might later be regarded as an intermediate step to a further final result. There was a strong call to continue to measure intermediate results, and to reflect more on the interim stages of impact. Many submitters supported valuing and measuring academic impact and development of human capital — whether as outputs that lead to improvements in further research that may eventually have an impact, or as a component of impact itself.

Of the 59 submissions, 41 directly addressed this discussion point in whole or in part.

4.1 Definitions and terminology

Of those submitters who expressed a view on this part of the discussion point, most supported aligning the definition of impact used in New Zealand with international usage, particularly that of the OECD. This view was strongest from research organisations and tertiary education organisations. Other submitters recommended keeping the NSSI definition but updating it, particularly in relation to time-frames. A few submissions noted that the NSSI was a 10-year strategy and therefore the definition should be retained.

A few submitters also called for a definition to be used consistently across the New Zealand public service, and accepted by the research community, though it was also pointed out that different definitions might be appropriate in different circumstances. Useful elements in a definition of impact were thought to be a reflection of a long time-frame, and inclusion of any potential consequences of science funding that are valued as policy objectives.

There was a general desire for definitions to be clearly articulated and consistently used:

> *We absolutely need a common definition of impact which is consistent with international convention…The common definition needs to apply, and be used uniformly, across MBIE and other government organisations. It also needs to be accepted by the research organisations.*
>
> *The changing definitions and emphases over previous MBIE funding rounds has caused confusion.*

A few pointed out that the usage of terms such as impact wasn't clear or consistent throughout the paper.

In discussing impact, it was thought necessary to mitigate the risks of skewing investment in favour of applied (versus fundamental) science, and how a focus on impact would reduce risk-taking and inhibit discovery.

4.2 Long-term or final results?

As noted, many submitters said that seeking to measure final results would not be possible because of the long time periods involved (longer than the research activity), and because what seems final at one stage might later be regarded as an intermediate step to a further final result. Research has a continuous nature, meaning that effects can be long term but they are often not final.

> *Determining the final point of a causal results chain is impractical and it disregards the cumulative nature of science and research production.*
>
> *Impact is about demonstrating value, and this happens right along the results chain…Are final results ever actually final?*
>
> *Final results are essentially unknowable.*
>
> *Restricting impact to the 'final' or 'end' point is not workable in practice. 'Final' presupposes that an impact chain neatly ends. The nature of the research to impact chain is that a final end-point cannot be identified.*

A few submitters pointed out that the definitions of these terms weren't clear in the paper, for instance, whether 'long-term' meant long-lasting or slow to have impact.

Many submitters pointed out that attribution was more difficult the longer the time-frame. As time went on, attribution back to the underpinning research became more difficult. Other points made were that impacts (both positive and negative) result from a combination of scientific and non-scientific outcomes. Given attribution difficulties, the framework could incorporate milestones that contribute to impact, or proxies for impact, but these measures would need to be chosen carefully with the right balance between prescription and flexibility.

4.3 Intermediate results, impacts and outcomes

Submitters differed on whether the discussion on impact and outcomes was helpful or whether section 3 became bogged down in semantics.

A common theme in submissions was that it was important to measure intermediate results, as it is more realistic to measure them and attribute them to activities. Several asserted that a final end-point can never be identified, so impacts become outcomes once further impacts occur, and what might be final later becomes an intermediate result.

> *If the only distinction between outcomes and impacts is time-frame, this seems unnecessary. Benefit is gained at all points along the chain and we are unconvinced there is value in trying to separate this out.*

There was a strong call to continue to measure intermediate results, and reflect more on the interim stages of impact. Submitters also said that the pathways to impacts and the impacts themselves should be recognised as distinct.

Some submitters also made the point that the linear model was a gross simplification of the scientific process which is iterative and involves many institutions and players.

Another point made was that as impacts don't usually occur until after research is completed, reporting during the research should reflect work being on track to achieve intended outcomes, rather than assess whether outcomes have been achieved. Intermediate outcomes could be assessed to indicate the likelihood of impacts being achieved in the longer term.

4.4 Inclusion of human capital and academic impact

Submitters supported valuing and measuring academic impact and development of human capital. While some supported measuring these as outputs that lead to improvements in further research that may eventually have an impact, others saw them as an important benefit of research and a component of impact itself.

Other points made include:

- Impact, however it is defined, must include assessment of the effects of research on the whole range of users and not just increased knowledge in the research community.
- The definition of academic impact in this section of the discussion paper is too narrow, and bibliometric measures need to be blended with societal and economic measures including engagement with potential users.
- If human capital included levels of health, it shouldn't be excluded from the definition of impact.

4.5 Other issues raised

- New Zealand should look at how other science/research systems are dealing with impact, and not 'reinvent the wheel'. This would involve learning more from other countries what has worked and what has not worked, particularly in the challenge of increasing impact and not simply measuring it.
- One challenge is that science may have a negative (or positive) impact in the short term but positive (or negative) in the long term.
- Research may deliver a nil finding, which is still of value, but it is unclear how that would be assessed in an impact-measurement framework.
- Is there too much focus on impact, and not enough on relevance, efficiency, effectiveness and sustainability? Is the focus on impact at any cost?
- There is a lack of clarity around primary/secondary and direct/indirect impacts.
- Evaluation should be a regular and developmental process.
- The term 'wellbeing' is not helpful.

5 What does impact look like?

Discussion point: Should the science system adopt the Treasury's Higher Living Standards Framework *to assess and organise the impacts of science? What about the other impact categorisation frameworks, such as that proposed by the Small Advanced Economies? What are the reasons for your views?*

No categorisation framework received clear support from submitters. Across almost all categories of submitters there was about the same level of support for the Treasury Higher Living Standards Framework, usually with some qualification or suggestion for adjustment; either against this framework or for an alternative framework. Many other submitters either didn't comment on this discussion point or specified that they had no preference from the range of frameworks discussed.

Out of 59 submissions, 42 directly addressed this discussion point in whole or in part.

5.1 Treasury framework

Reasons given for supporting this include:

- Focuses on four distinct types of capitals.
- Allows consistency across the public sector to enable shared monitoring, evaluation and reporting.
- Is broader than the NSSI (which has a narrow view of health).
- Has five categories as opposed to six in the Small Advanced Economies taxonomy.

Other support was more nuanced:

- Agree with it despite its strong economic bias.
- It is useful but not sufficient.
- Differences between frameworks seem subtle, even semantic. Having got used to the Treasury framework, may as well continue with it.
- The Treasury framework has some value as a heuristic tool.
- It is useful and consistent with other frameworks mentioned, at the level of specification presented in the document, but not necessarily in terms of lower-level specification of indicators.
- Scientific impact may not be evenly distributed across this framework.

Recommended improvements:

- First determine the strategic aim for the New Zealand impact model, and use or modify the Treasury framework if it fits.
- New Zealand science system should adapt or define the impact targets using examples such as the US National Science Foundation.
- Inclusion of Vision Mātauranga or a Māori world view.
- Inclusion of health benefits/research impacts, capability development, international engagement, environmental impacts and the concept of intellectual capital (the value of knowledge).
- A better definition of success in the five areas is needed.

Reasons for not supporting it:

- Too abstract and complex.
- Wrong, inadequate and out of date.
- Conceptually unclear.
- Too limited, as it does not acknowledge the role of intellectual capital, skills development and training.
- Limited compared with the SAEI framework.
- Need a general framework. See literature on the reduced usefulness of a capabilities-based framework.
- It is intended for policy context, not research, and doesn't follow the OECD approach.
- Its use of four types of capital and five aspects that can be affected by policies is unnecessarily complex.
- It is not widely used, and a better approach would be to employ a framework that is already widely used.

5.2 Small Advanced Economies Institute (SAEI) framework

There was some support for this. Reasons included because it was comparable internationally and more appropriate than the Treasury framework, which relies primarily on economic impact and less on broader impacts.

Some submitters suggested use of a modified SAEI model, adapted for New Zealand circumstances (eg, through incorporating Mātauranga Māori) and mapped onto the Treasury Higher Living Standards Framework for long-term impact assessment.

5.3 National Statement of Science Investment impact framework

Among research and tertiary education organisations there was some support for the impact framework in the NSSI, perhaps with some adjustments to the definitions (including drawing on the Treasury framework for additional granularity). It was pointed out that the classification applied in the NSSI was consistent with pillars 1, 2 and 3 of the SAEI Research Impact Framework (and the other three pillars are actually contributors to the first three).

5.4 Other frameworks

A few submitters suggested devising a new framework, combining the best elements of existing frameworks:

- Worth considering combining the Treasury framework with the concepts outlined in the proposed impacts framework.
- The UN's Sustainable Development Goals might be a useful high-level framework.
- Best to merge Treasury framework with others to make it more comprehensive, for instance by including equity and impacts of policy.

One university submitter preferred the framework proposed by Motu.

5.5 Other issues raised

- As the framework used in New Zealand needs to align with international practice, perhaps a better question would be "What is the most universally recognised framework utilised by those international communities that New Zealand most frequently interacts with and aspires to being compared with and/or aligned to?"
- Treasury, SAEI and OECD framework are all similar, so it's best to make a pragmatic choice for whatever resonates best with stakeholders. The Treasury framework is not widely used, even within Treasury, so there is no reason to prefer it over the others.
- Impact frameworks are useful, but the dominant requirement remains contribution to (old) portfolio-aligned impacts.
- Need guidance to accompany any framework, including on how impact is described in different contexts and how to evaluate within frameworks and lessen the degree of subjectivity.
- Any framework must identify the diverse areas where research benefits can accrue.
- MBIE should engage with stakeholders when determining what is important in evaluation.
- Impossible to respond to this question in absence of criteria that can be used to assess frameworks against the government's aims.
- Caution against tying definitions to any particular framework, as frameworks evolve or are replaced by newer frameworks.

6 How and when is impact generated? — generic results chain

Discussion point: How well does the generic results chain capture the science system at a high-level?

Approximately twice as many submitters who addressed this question supported use of the generic results chain to some degree, compared to those who didn't support its use. This was the generally the case across all categories of submitters, but support was lower among research organisations.

Of the 59 submissions, 42 directly addressed this discussion point.

There were three discussion points under section 5 (How and when is impact generated?), which were presented in a different order in the list of discussion points on page 42 than in the text of the paper. Sometimes two or three discussion points from this section were answered together.

Only a few submitters, mostly tertiary education organisations, supported this model without qualification or with only minor suggestions for improvement:

- Generally helpful, but could be criticised as too linear. Some tweaks would be useful: multidimensional categorisation of benefits; collaborative approach between researchers and potential users; influences between these two aren't just unidirectional arrows with no feedback loops.
- Describes science system well at the high level, but misses the relevance of the work especially from end-user perspective.

Among research and tertiary education organisations, almost equal numbers of submitters either gave qualified support for the generic results chain, or did not support it. Qualified support for the generic results chain was often accompanied with significant reservations:

- Generic results chain is logical but highly simplified.
- Generic results chain is too linear. In practice there are complex interactions within a larger system.
- Useful only at a high level, but does not capture real-world complexity.
- It lacks feedback loops.
- Negative results are not a failure, yet a simple impact model will devalue them.
- Negative impacts of the research system aren't mentioned. Investing too much resource in identifying positive impacts may distort views of the research system output.
- It doesn't identify potential roadblocks and points of failure along the chain.
- There are huge variations in the rate of movement along a results chain.
- Need to include human capital as an output.
- Needs to be open to adaptation for different disciplines and situations; cannot be universally applicable.
- Public engagement activities aren't considered.
- Public policy should be acknowledged as an input defining science needs.
- Use of knowledge capital by the public very hard to measure in any meaningful way. Such a measure is aspirational and too broad to be of any use.

Some submitters did not support the generic results chain model at all:

- The generic results chain model is conceptually simple and useful only as an illustration, and needs to be developed to better convey the complexity and feedback loops that exist, and avoid the impression of linear flow. It fails to capture cyclical nature of academic research; consuming, contributing and re-consuming research activities.
- The model greatly simplifies what are complex realities. The role of serendipitous discovery not recognised: "The serendipitous discovery often has more value than achievement of the original research aim."
- A networked model of science and innovation is more applicable.
- Science needs to be seen as a service system with the customer at the centre, co-creating value.
- It misses out the scale of science; projects are small and scientists act as integrators of ideas. What level does the chain operate at?
- The generic results chain is not very effective for a not-for-profit research organisation with close ties to industry, where the implementation path is hard-wired. The application of research requires the involvement of industry.
- The generic results chain model shouldn't be used for assessment unless its limitations are recognised and evaluated.
- Simple chains lead to reductionist thinking; intervention is not the language of science or its application, but the language of policy.

… a chain model might help to partly explain how impact can emerge from research, but the ways in which impact can happen are so complex and varied that this model would not be useful for assessment…If used, such a model could lead to inflexible, risk-averse gaming behaviour.

It is important that the generic results chain is not assumed to apply to public research in the same way as other more predictable areas of innovation, as this is by and large not the case.

The generic results chain does not capture the context for the science system. It is neatly contained in a box as though it is separate from society where consumers, markets and other forces that shape what is important for science to address are located. It is also portrayed as very linear, as though outcomes will flow to impacts in an automated manner. The arrows are unidirectional, not allowing for feedback and reflection on priorities or activities.
A networked model of science and innovation would be more progressive and reflect what we have come to understand about the context for science and how science makes a difference. A less deterministic approach to appraising science would be more constructive.

Other points raised

- Is there any evidence to suggest this results chain is appropriate? Have pilot studies been done to test it?
- Does the New Zealand science/research sector have enough skilled people to perform such analysis?

- Need more clarity between 'pathways to impact' as a concept and a results chain as a way of mapping it.
- The paper omits consideration of the sixth element of the result chain: feedback. Where is the feedback link in this model?
- The paper recognises the complexity of the science to impact pathway, yet takes a simple linear view that is inappropriate.
- The OECD Development Assistance Committee (DAC) model relates to evaluation of international development assistance, and isn't directly transferrable to the New Zealand science/research sector.
- Attaching an identifier to research activity rather than an individual researcher or research group will make tracking the results chain easier. The Australian RAiD project (Researchers in Agriculture for International Development) should be watched.

7 How and when is impact generated? — worked examples

Discussion point: How could the worked examples on pages 28–32 be improved?

Of the 33 submissions that responded to this discussion point, 27 (46 per cent of total submissions) directly addressed the question of the worked examples. About half of them gave qualified support for the examples, but often with significant reservations. Of the remaining comments, about equal numbers either supported the examples without qualification or considered them to have little or no use.

Some submitters thought the examples were useful without qualification.

> *… the worked examples are good and better capture some of the complexities [of the result chain]*

About half the relevant submissions considered the examples to have some merit, but to be of limited value for different reasons:

- Simplistic/idealised, not related to real world. Don't represent the science system. Simplistic in terms of academic/end user relationships and knowledge transfer.
- Too linear. Need to show multiple pathways and loops.
- Great leaps made between outcome to outcome, or outcome to impact.
- Separating intermediate outcomes and outcomes and impacts can be confusing.
- Need to articulate at what level the worked examples operate.

Many specific problems were identified, or suggestions made to improve the examples:

- 'Theories and findings' as an input to researcher activities is missing; there is a vital feedback loop of data re-use.
- The two outcomes on the top row are of a different order: knowing, and doing.
- Might be more useful if re-worked as template for researchers to use and test.
- Need examples of HASS, interdisciplinary research, research relating to primary industries, inconclusive or negative findings, impact at a sector or funder level, community-initiated research.
- The worked examples in the UK Association for Innovation, Research and Technology Organisations report are worth reviewing.
- Provide more details on activities relating to dissemination and stakeholder engagement.
- Include Vision Mātauranga.
- Rework to show science as a service system.
- More closely align to categories captured in generic model.
- Case studies would be useful.
- Include a wider range of capitals.
- Allow for serendipity.
- Show FTE/resources at different stages to show how much (little) 'actual science' is getting done.
- Look at discipline-specific guidelines in US National Science Foundation impact statement requirements.

- Include benefits to New Zealand's international reputation, and value of maintaining status quo/supporting resilience.
- Could include examples of negative impacts.

The worked examples need more detailed analysis of real examples, covering the strengths and weaknesses of theory-based tools and how to use them in a complex environment.

The examples have some value in describing pathways, particularly in the immediate steps around uptake. However, they do suffer from the same problems as the results chain models, so that great leaps are made from output to outcome, or outcome to impact.

Some submitters considered that the examples were of no use:

- Examples in paper just reinforce the problems with impact (eg, long timeframes, complexity, accountability, responsibility) and thus argue against impact evaluation.
- Need to clarify purpose of examples.
- Not a good fit for research organisations with close industry ties.

Patterns within and between categories of submitters

Most submissions from tertiary education organisations thought the worked examples were useful, with or without some modifications. Many research organisations didn't comment, and those who did presented a range of views. In other sectors views were reasonably evenly spread.

8 How and when is impact generated? — mechanisms or processes

Discussion point: What are your views on the mechanisms or processes for generating impacts? What intermediate outcomes are especially important?

There was some support for the approach taken in this section:

> *The statements on key mechanisms seem very logical and put a great case for their inclusion as intermediate outcomes.*

In general, though, submissions reflected the complexity of the topic as outlined in the discussion paper. Submitters highlighted the absence of clear definitions for impact and outcomes, challenges of long lags, the uncertain nature of science, and the appropriate level of granularity for assessment.

Overall 38 out of 59 (64 per cent) of submissions directly addressed this discussion point. The response rate was highest from research organisations (71 per cent) and tertiary education organisations (83 per cent).

8.1 General comments

The challenge of terminology was a common theme. The absence of agreed definitions for impacts and outcomes made it difficult to address this discussion point. While it was important to have clear and consistent terminology, the difference between outputs and impacts would always be blurred and somewhat subjective.

The methods and processes for generating impact are much more complex than can be captured by models, and there is a lack of evidence for factors that can predict the successful translation of basic research to application. Serendipity is thought to often play a role. Differences in time-frames and the scale of assessment also contribute to the challenges in dealing with mechanisms and processes. Vision Mātauranga seems to be missing from this part of the discussion.

8.2 Mechanisms and processes for generating impacts

Submitters noted the challenges in identifying mechanisms or processes for generating impact:

- The possible pathways from research to impact are very context dependent, and even after much study it will be possible to make only general statements about which are most effective. The process by which a particular piece of research makes impact will depend on the research, and the ability of both researchers and end users to make connections toward impact. Deciding key mechanisms in advance could be a constraint. It is also necessary to consider spill-over impacts.
- It would be advantageous to put more emphasis on identifying research needs before setting research agendas, including through further engagement with end-users.
- Impact assessment must use pragmatic proxies, and different research projects will need different proxies for impact.

- It is often more feasible to measure impact on policy (broadly defined) than on later categories of impact, and it may be necessary to include some of these earlier items as impacts.

Other points were noted:

- It is difficult to attribute impact to New Zealand government investment in science, because science is international and the vast majority of research outputs available in New Zealand are generated in other countries.
- A service system model should be used to identify key mechanisms or processes for creating value or impact.
- Mechanisms and processes are well defined in the relevant Small Advanced Economies Institute document.

An issue raised again in response to this section of the paper was that generating impact is largely out of the hands of the researchers and independent of the excellence of the research, and that the mechanisms for generating impact and the accountability for it lie elsewhere.

> *At no point is there a direct link from the research to the impact — there is instead a major disjunct — so that impact is always mediated by the presence of stakeholders/end-users who sit between the research and its (long-term) impact. This has significant implications for evaluation processes and methodologies, as well as accountabilities. Impact is only ever achieved once stakeholders/end-users make decisions, and even then there are always many additional factors, inputs and activities that will contribute to impact. What is crucial for understanding is that the key decision points that directly precede impact are out of the control of funding agencies and research organisations. This has important implications for how the issues of control, accountability and responsibility can be conceived and applied in the impact pathway — issues that are conspicuously absent from the discussion paper.*

Other submitters addressed this point, and highlighted the importance of identifying and supporting mechanisms for enhancing uptake/adoption of research. They called for more effort to reduce barriers to using research, to enhance impact, and more emphasis on implementation pathways. Making research results readily and freely available was seen as part of that. Engagement with end users and with the general public was seen as an important mechanism for generating impact(s).

> *There is a growing international specialist community of impact-related experts (eg, pre- and post-award research managers, impact officers, knowledge transfer/exchange specialists, information managers, public engagement specialists) whose skillsets are essential for research translation. Within the UK we are yielding the value of these skills for the Research Excellence Framework, and witnessing the growth of a highly-skilled workforce for increasing impact capacity. Our experience demonstrates the crucial role of valuing, building and upskilling these professional roles for impact to become embedded in the research process.*

8.3 Intermediate outcomes

A range of intermediate outcomes were thought to be important including:

- improvements in academic impact, and human, economic, social and natural capital
- all the outcomes described in the discussion paper are important in the context of the NSSI
- any intermediate outcomes that could be expected to lead to longer-term impacts.

Other outcomes were suggested for consideration including:

- spill-over impacts
- changes to legislation
- socioeconomic, environmental and creative intermediate outcomes
- intangible outcomes and values
- changes to the practices of non-profit groups
- changes to teaching practices
- professional development and upskilling of staff
- collaboration
- innovation that is not related to industry.

There were mixed views on the OECD's intermediate outcome mechanisms:

- They are bluntly economic and don't fit the New Zealand science/research context, and some 'intermediate outcome mechanisms' look more like outcomes than mechanisms.
- Those that fall into the ‘outcomes’ space are helpful. More helpful still would be to associate each of these outcomes with an anticipated impact, eg, ‘the improved exercise of professional skill, for example in research-based improvements in medical practice’ can be readily associated with one or more impacts in the area of health.

General problems with identifying intermediate outcomes included problems with long time-frames and attribution, and that the relative value of intermediate outcomes would depend on the discipline.

9 Implementing an impact agenda

Discussion point: What are your views on the balance between ex-ante and ex-post evaluation? What principles should underpin an ex-post evaluation framework? What data should be collected on the use of knowledge and how might it be collected?

Of the few submitters who provided views on the question of 'balance' between ex-ante and ex-post evaluation, the majority cautioned against trying to find a balance because the two types of evaluation are carried out for different purposes. The lack of an evidential basis for ex-ante evaluation was highlighted by a number of submitters. Many submitters recognised the difficulty of conducting ex-post evaluation, but almost all who commented on this discussion point either expressed a desire for more or made suggestions for how it might be improved. Some submitters pointed out that increased impact measurement would impose a cost – potentially significant, and suggested that the burden of evaluation should not fall exclusively on researchers.

Out of the 59 submissions, 42 directly addressed this discussion point in whole or in part.

9.1 Balance between ex-ante and ex-post evaluation

Despite the high response rate to this discussion point, only a few provided views on the question of 'balance' between ex-ante and ex-post evaluation. Of those who did, the majority cautioned against trying to find a balance because the two types of evaluation are carried out for different purposes.

> *Ex-post and ex-ante evaluation are related but distinct undertakings. I don't think it makes sense to speak of a 'balance' between them. We undertake them for different reasons.*

> *…the two are complementary…we therefore see little value in distinctions around the relative value of either and believe both must be pursued in tandem.*

Others responding to this aspect of the discussion point called for more ex-post evaluation; not necessarily for the sake of 'balance', but because it is not a strong feature of the New Zealand research system.

> *The absence of ex-post evaluation currently leads to reduced credibility for some of New Zealand's funding mechanisms.*

9.2 Ex-ante evaluation

The lack of an evidential basis for ex-ante evaluation was highlighted by some submitters:

- Difficult to predict the future.
- Lacks an evidential base.
- The proposal with "the biggest lies" will win.
- At best an educated guess.
- Rewards promises made rather than a track record of excellence, delivery and impact.

It was also pointed out that ex-ante evaluation cannot assess the importance of serendipity (unintended outcomes or benefits).

Different submitters highlighted the tension between demonstrating impact while retaining opportunities for 'blue skies' research.

> *Ex-ante evaluation is critical to demonstrate possible pathways to impact as well as aligning with impacts that are perceived as most important to funders.*
>
> *…programmes need to support impact at some point in time, but there must always be room in the system for blue-skies research…what will we miss out on if we require everything to have a line of sight to uptake?*

Suggestions were made to improve ex-ante evaluation:

- Instead focus evaluation on whether proposals demonstrate: excellence; capacity; stakeholder engagement and consideration of Vision Mātauranga where appropriate; development of emerging researchers; and where appropriate considered pathway to impact or relevance to funder's question. Quantum of potential impact is also relevant.
- Include views of potential end-users, and not only those of researchers.

9.3 Ex-post evaluation

Many submitters recognised the difficulty of conducting ex-post evaluation, but almost all who commented on this discussion point either expressed a desire for more or made suggestions for how it might be improved.

The difficulties were widely canvassed, for instance:

- Ex-post evaluation is nice in theory but hard to do.
- 'Unsuccessful' research also generates impact, but it is not clear how this would be captured in ex-post evaluation.

> *It might be useful to consider why ex-post evaluation hasn't developed — what has prevented it, and are those barriers still in place?*

Linking ex-post evaluation with ex-ante assessment

Submitters pointed out the value of using accumulated knowledge from ex-post evaluation to make improvements in ex-ante evaluation, for example:

> *A gap in the New Zealand system is significant ex-post evaluation that could be matched with the ex-ante evaluation for a given project to determine if the original predictions were realistic.*

But other submitters highlighted problems with this in terms of scale and time-frame:

- Time-frames are so long the feedback value of ex-post evaluation is limited.
- Ex-ante assessment (which is not evaluation) must be at a more granular level, which makes it difficult for ex-post evaluation to inform it.

Resources

The resources needed were also pointed out:

- Resources applied to this need to be proportionate to benefits; impact assessment itself needs to show value for money.
- Ex-post evaluation should be done independently. In any case researchers can't do this because of the long time-frames involved, and a lack of resources.
- Ex-post evaluation should be done by funders.
- The work required to develop a practical reporting framework needs to be centralised.
- Reviewers must be appropriately skilled.
- There is a need to involve end-users/stakeholders.
- Evaluative reporting should replace compliance reporting, not add to it.
- There are few incentives in the New Zealand system to articulate and evidence impact. Should there be ring-fenced funding for this, and more investment in ex-post evaluation? Canada and Switzerland have mandated evaluation systems.
- Would putting more effort into formative evaluation (eg, to improve outcomes, implementation and uptake) be a better use of resources to deliver NSSI goals such as better performance or agility, as well as a more enhanced contribution to impact?

Methodology

Suggestions were made about methodology to use for ex-post evaluation:

- A mixed methodology is recommended, depending on the sector. Qualitative case studies are most used overseas. Suggest resource-efficient collection of a limited number of case studies.
- It is necessary to avoid metrics that encourage gaming of the system.
- An agreed framework should be co-developed with research providers. The current workstream championed by iPEN (Impact Planning and Evaluation Network) is referenced.
- There is potential for meta-analysis to identify common elements necessary for success, supplemented by 'deep dives' by MBIE into aggregated data. Multiple data sources must be used.
- It is necessary to identify reasonable proxies for evaluation.

There was some discussion of the level at which ex-post evaluation should be carried out:

- This should be done at a collective level (research organisation, fund or field of research), rather than for an individual researcher or project; even a system-wide evaluation of impact.
- Ex-post evaluation at the fund level, supplemented by deeper case studies, would be sensible, plus a system-wide evaluation of impact.
- There is a need to identify reasonable proxies that don't lead to perverse behaviour through researchers aiming to maximise proxies rather than impacts for the benefit of New Zealand. This suggests system-level analysis rather than fine-grained.

Data sources and collection

- New Zealand needs a national approach to collecting data or metadata, and building a research information management system to assist with evaluation. New Zealand is falling progressively behind in this area.
- Balanced comprehensive ex-post evaluation is not possible until there is greater adoption of multiple data standards, and attribution mechanisms are embedded and

managed. This is time-consuming but can be made more efficient by incentives to participate in research infrastructure.

- The National Research Information System should be linked to the measurement of impact to achieve consistency, minimise duplication of effort in the system and support decision-making on where the government needs to invest. The problem of attribution will need to be addressed. Multiple sources of data are needed. The National Research Information System should not be the only source, but one of several.
- The burden of data collection should be on the government, not researchers.
- It would be worthwhile examining what different national and international institutes and agencies are doing, and assess how cost-effective and useful these different approaches are.
- Data collected should comprise:
    - any external research income inputs
    - description of pathway(s) by which claimed impacts have been achieved
    - likely counterfactual
    - other significant contributions to the impacts
    - quantitative and qualitative evidence of claimed impacts
    - analysis tags including location, type of impact and funder identity.
- Data used for ex-post evaluation should include numbers and types of science FTEs, voters' views on science, industry (by sector) view on the value of science, demographics.
- Measures of academic influence are not appropriate markers of real-world effects.

The task of government is to collect and make available data on the inputs, activities and outputs of public research, in a way that allows these data to be used by researchers and linked to other data. These data are the foundational infrastructure of research on the impact of science. Once they have been collected for some period of time and made available as the basis for research, the research community will develop methods for tracing impacts and characterising impact pathways.

The impact of science lies outside of the science system itself, which means that the data needed for evaluation is within the sectors aligned to the science and in the long term may lie across a number of sectors. Ex-post evaluation is extremely challenging and results are likely to be ambiguous and we suggest using a multi-method approach.

Principles

Other submitters suggested principles for ex-post evaluation:

- Principles for evaluation:
    - scope should be proportionate to project's importance
    - allocate sufficient resources at the outset to design and undertake the evaluation
    - develop a shared vision and agreed evaluation questions with partners and stakeholders, with measurable indicators and identified data sources

    - assign roles and responsibilities to ensure evidence of impact after project end continues to be collected and analysed
    - identify mechanisms to ensure evaluation results are used to inform future decisions.
- Principles of ex-post evaluation include purposefulness, demonstrability, proportionality, connectiveness and contribution.
- Suggested principles for an ex-post evaluation framework:
    - consistent across all government funding sources in New Zealand
    - applicable to all research disciplines
    - allow for lapse of time before impact occurs
    - don't attempt an exclusive or finite list of impacts
    - impact evaluation must be funded
    - minimise compliance costs
    - be able to deal with commercially-sensitive information
    - should use the individual researcher as the unit of analysis
    - the researcher's institution should provide the data, with evidence
    - avoid duplication of effort, eg, with Performance-Based Research Fund (PBRF).
- Include both qualitative and quantitative data in a mixed method approach to enhance validity and reliability, including from holistic peer review.

Time-frames

Concerns were raised about the impact of the long time-frames involved:

- Who is able to track the impacts of research after a project is completed?
- How will continuity of ex-post evaluation be ensured across governments, or even MBIE research strategies?
- The long time periods involved may mean that the team being evaluated is not the one involved in the research, even if the provider is the same.

9.4 Other points raised

- PBRF occurs after funding but before completion, so is there a third assessment stage besides ex-ante and ex-post? How likely are researchers to change their behaviour regarding assessment while this continues? No long-term impact assessment was added to the PBRF in the recent review.
- Worth looking more closely at international examples of evaluation practice.

The complexities and limitations of any evaluation are well described in the discussion paper. What is not clear, is how these will be managed or mitigated in any framework adopted.

Appendix 1 List of submitters by category

Research organisations

- AgResearch
- ESR (Institute of Environmental Science and Research)
- GNS Science
- Landcare Research
- NIWA (National Institute of Water and Atmospheric Research)
- Plant & Food Research
- Scion
- Cawthron Institute
- Centre for Research, Evaluation & Social Assessments
- Malaghan Institute
- New Zealand Leather & Shoe Research Association
- Independent Research Association of New Zealand
- KiwiNet
- Science New Zealand

Tertiary education organisations and associated entities

- Massey University (Assistant Vice-Chancellor, Research Academic and Enterprise)
- University of Auckland (Deputy Vice-Chancellor, Research)
- University of Otago (Biochemistry Department)
- University of Otago (Deputy Vice-Chancellor, Research and Enterprise)
- University of Otago (Library)
- Victoria University of Wellington (Ferrier Research Institute)
- Victoria University of Wellington (Vice-Provost, Research)
- Auckland UniServices
- Lincoln Agritech
- Otago Polytechnic
- MacDiarmid Institute
- Association of CoREs

Sector-wide organisations and funding bodies

- Royal Society Te Apārangi
- Health Research Council
- Marsden Fund Council

Government

- Ministry for the Environment
- Ministry for Primary Industries
- Office of the Prime Minister's Chief Science Advisor

- Regional Councils Science Advisory Group

Business sector

- Dairy NZ
- Federated Farmers of New Zealand
- Water New Zealand
- Clarivate Analytics (Australian office)
- Elsevier (Australian office)

Other organisations

- Association of Research Managers and Administrators (UK)
- eResearch 2020
- New Zealand Association of Scientists
- New Zealand Grassland Trust and the New Zealand Grassland Association
- New Zealanders for Health Research
- Occupational Therapy New Zealand
- Science Media Centre
- High-Value Nutrition National Science Challenge

Individual

- Jane Allison, Massey University
- Troy Dougherty, Nuenz
- Stephen Hanney, Brunel University (UK)
- Adam Jaffe, Motu Economic and Public Policy Research
- Bill Kaye-Blake, PwC
- Jennifer Lees-Marshment, University of Auckland
- Nicola Paton, University of Auckland
- Wayne Patrick, University of Otago
- Jane Shearer, Resolutionz Consulting
- Alistair Sheat (former scientist and research manager)
- Simon Smelt (economist and policy analyst)
- Fernanda da Silva Tatley, University of Otago
- Rutherford Discovery Fellowship recipients (45 individuals)

Appendix 2 List of abbreviations and acronyms

CoRE	Centre of Research Excellence
CRI	Crown Research Institute
DAC	Development Assistance Committee (of the OECD)
ESR	Institute of Environmental Science and Research
HASS	humanities, arts, social sciences
iPEN	Impact Planning and Evaluation Network
IRANZ	Independent Research Association of New Zealand
IRO	independent research organisation
MBIE	Ministry of Business, Innovation and Employment
NIWA	National Institute of Water and Atmospheric Research
NSSI	National Statement of Science Investment
OECD	Organisation for Economic Cooperation and Development
SAEI	Small Advanced Economies Institute
STEM	science, technology, engineering, mathematics