MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
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Marsden Fund: Assessment of Strategy and Management

Report to the Minister of Science and Innovation

New Zealand Government

Contents

Executive summary

Budget 2016 saw a substantial increase in funding for the Marsden Fund. The Minister of Science and Innovation commissioned the Ministry of Business, Innovation and Employment (MBIE) to undertake a review of the strategy and management of the Marsden Fund and provide advice on how to maximise the long-term benefit to New Zealand from continued investment in investigator-led research through the Fund.

The Marsden Fund is highly regarded, well run, and effective at selecting high-quality research within its current settings. It has delivered a range of novel research with benefits to New Zealand. A greater proportion of Marsden-funded research appears in top-ranked journals than the average for New Zealand and for the small advanced economies (New Zealand, Singapore, Finland, Switzerland, Denmark, Israel and Ireland).

As the level of funding has grown over the years, the Marsden Fund Council has made incremental changes to the funding process. More recently, the National Statement of Science Investment (NSSI) has updated and clarified what government expects the science sector to deliver.

Having reviewed the Fund in the light of the change in government's expectations and the increase in funding, we consider that some changes are needed to place the Marsden Fund in good stead to continue to invest in excellent investigator-led research into the future.

As the available funding and number of awards grows, the Fund's ability to incentivise and select the best proposals may be constrained by current Fund settings. There are also broader issues with governance, transparency of process and alignment with the NSSI.

Our recommendations are primarily focused on challenges facing the Fund in the near future and the opportunities presented through significant additional funding.

Key recommendations to address these issues are:

- strengthening the Marsden Fund Council by introducing international representation and building governance experience
- aligning Fund objectives more closely with the NSSI concepts of excellence and impact
- developing an Investment Plan supported by a performance framework
- increasing the transparency of assessment processes
- considering alternative assessment panel processes, grant types and sizes.
- appointing an international review panel to periodically evaluate the Fund and the research it supports.

Implementing these recommendations will substantially improve assurance for government of the Fund's long-term benefit to New Zealand.

This report will form the basis for MBIE's advice to the Minister of Science and Innovation on how to maximise the long-term benefit to New Zealand from continued investment in investigator-led research through the Fund.

1 Introduction

1.1 The National Statement of Science Investment sets out the government's vision for New Zealand's science system

In October 2015, MBIE released the National Statement of Science Investment (NSSI). It sets out the vision of "a highly dynamic science system that enriches New Zealand, making a more visible, measurable contribution to our productivity and wellbeing through excellent science".

In addition, the NSSI sets out the following goals for the science system of 2025:

- a better performing science system that is larger, more agile and more responsive, investing effectively for long-term impact on our health, economy, environment and society
- growth in Business R&D to well above 1 per cent of GDP, driving a thriving independent research sector that is a major pillar of the New Zealand science system
- reduced complexity and increased transparency in the public science system
- continuous improvement in New Zealand's international standing as a high-quality R&D destination, resulting in the attraction, development and retention of talented scientists, and direct investment by multinational organisations
- comprehensive evaluation and monitoring of performance, underpinned by easily available, reliable data on the science system to measure our progress towards these goals.

The NSSI commits to growing government's investment in science to 0.8 per cent of GDP, as fiscal conditions allow.

1.2 The government invests in research where the social returns are high

The government's role is to encourage high-quality research for the benefit of New Zealand; achieve a balance of risk, impacts and timeframes in its portfolio; and be the principal long-term investor in research where social returns are potentially high but private returns are uncertain. The government wants to see a society fully engaged with and benefiting from a larger, more engaged and more responsive science and innovation system that leverages strong international connections.

The NSSI's vision requires all parts of the system to strive for greater excellence[1] and impact[2] in all science undertaken, with our science being of the highest quality possible, and most public investment having a clear line of sight to eventual impact. The focus on impact does not mean a focus solely on close-to-market or end-user-driven research.

[1] Excellence – see page 13 of the *National Statement of Science Investment 2015–2025*.

[2] Impact – see page 11 of the *National Statement of Science Investment 2015–2025*.

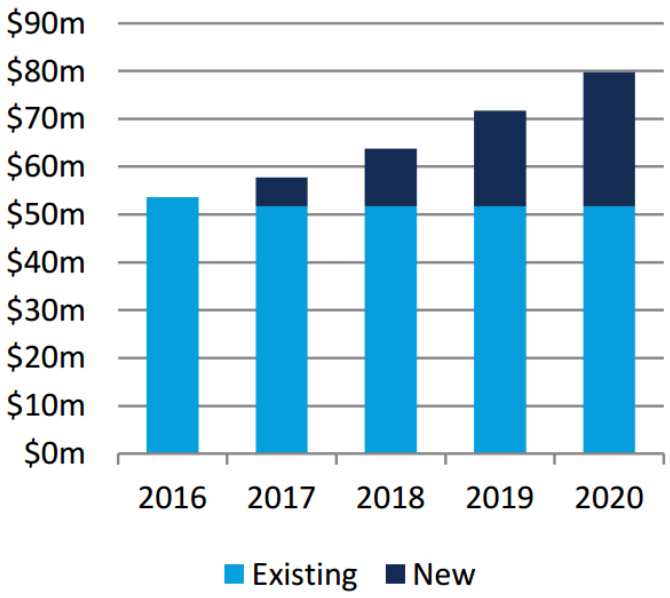
The NSSI identifies the dimensions of scientific excellence as shown below:

THE BEST PEOPLE	A RIGOROUS APPROACH	OPTIMUM RESULTS
Individuals, teams and institutions well placed and sufficiently skilled to do the research, who are sought-after practitioners in their field, with reputations for high-quality work, and linked internationally and domestically.	Well-defined, repeatable methodologies and careful implementation. Transparency and stringent peer review. Best-practice approaches. Builds on existing approaches. Risks identified and managed.	Expansion and application of knowledge, wide knowledge dissemination, high reliability and repeatability, strong application. International reputation enhanced.

1.3 Budget 2016 increased funding for the Marsden Fund

Through the Budget 2016 Innovative New Zealand package, the government made significant new investment in investigator-led research, including the Marsden Fund (adding $28m, or around 50 per cent, to baseline funding by 2020), in support of the goals and vision identified in the NSSI. The funding profile can be seen in Figure 1 below.

Figure 1: Marsden Fund – existing and new funding 2016–2020



Source: The Estimates of Appropriations 2016/17

Since its inception, the Marsden Fund has increased greatly in value. In 1995 the Fund had an annual budget of $6m (approximately $9m in today's dollars). Following Budget 2016, this will increase to approximately $80m annually in 2019/20. It should be noted that the Fund was established before the full-cost funding policy (ie to make a contribution to institutional overheads) was introduced in 2001.

In the Marsden Fund Council's (the Council) response to the NSSI, it identified that any increase in funding for the Marsden Fund would enable them to:

- increase the number and size of awards, without a drop in quality, and support more of the best high-quality research in New Zealand – this would also ensure that research programmes are fully costed and, in particular, allow better funding of postdoctoral researchers and our best early-career researchers

- open the possibility of larger multidisciplinary awards, with the potential for greater impact, and in keeping with international trends, develop more cross-discipline collaborative research programmes
- leverage opportunities with overseas funding agencies and encourage more international cooperation, with the potential for greater impact from linking into international science and introducing new science and technology into New Zealand.

1.4 The Minister of Science and Innovation has commissioned this Assessment

In light of the significant new investment through Budget 2016, the release of the NSSI and the ongoing need to ensure that public money is being well spent, the Minister of Science and Innovation commissioned officials to assess the Marsden Fund's strategy and management and provide advice on how to maximise the long-term benefit to New Zealand from continued investment in investigator-led research through the Fund.

This report records the result of the Assessment of Strategy and Management (the Assessment). The findings will provide a basis for continued investment in the Fund and ensure that the Fund is in good stead to respond to future needs and opportunities. The Assessment also provides an opportunity to align the Marsden Fund with the NSSI, and with other investment mechanisms in the science and innovation system.

The Terms of Reference for the Assessment are attached in Annex 1. This report states our findings and recommendations from the Assessment.

The Assessment consisted of three main components:

- We reviewed relevant literature and material on investigator-led research in general and specific to the Fund (eg Gazette notices, Terms of Reference, and Marsden Fund Impact Reports), including comparisons with investigator-led funding mechanisms in other jurisdictions (eg European Research Council (ERC), Australian Research Council (ARC) and the Wellcome Trust).
- We interviewed key stakeholders, including Council members, funding panel members, departmental science advisors, institutions, and researchers, including successful and unsuccessful award applicants (see Annex 2 for a list of stakeholders we engaged with). The Council and relevant Royal Society of New Zealand staff were interviewed and engaged at regular points during the process. The questions for structured interviews are attached in Annex 3.
- We analysed Fund data and other information held by the Royal Society. Novel data collection was limited to consultation with key stakeholders.

We did not seek submissions as part of the Assessment, but a number of stakeholders provided submissions, including:

- the Computer Science and Information Systems communities in the tertiary sector
- New Zealand's digital technology industry bodies
- New Zealand Business Research Deans
- Science New Zealand
- the New Zealand Association of Scientists
- three submissions sent independently by university researchers.

We considered all submissions alongside the information from our proactive engagement with stakeholders.

Professor Aidan Byrne, recently retired Chief Executive of the ARC, was engaged as an expert advisor for the Assessment. As part of the Assessment, we visited the ARC to gain insight into how it operates its processes.

The remainder of the report is set out as follows:

- Section 2 outlines how the Marsden Fund functions.
- Section 3 provides an overview of the key issues in the literature.
- Section 4 sets out the findings of the Assessment.
- Section 5 offers recommendations.

2 The Marsden Fund

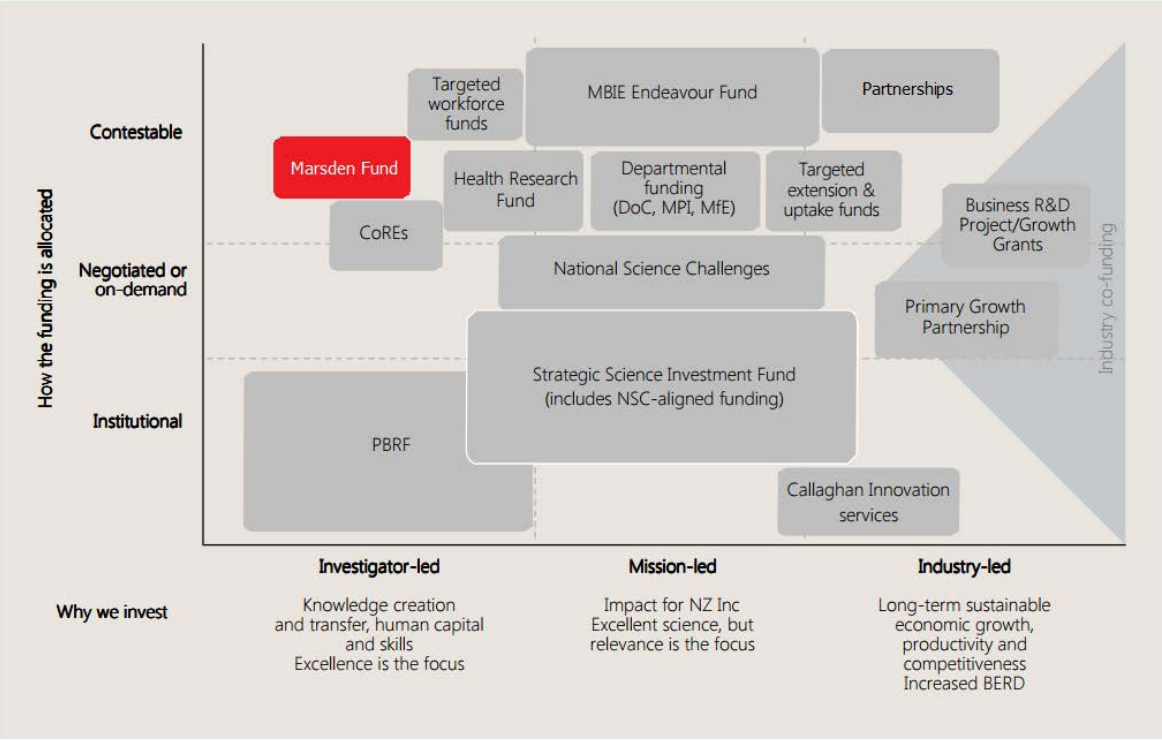
2.1 The Marsden Fund invests in excellent investigator-led research

The Marsden Fund, established in 1995, invests in excellent investigator-led research and is overseen by the Marsden Fund Council, appointed by the Minister of Science and Innovation.

Investigator-led research is undertaken to acquire new knowledge, but the direction of research is led by researchers. This type of research generates ideas, expands the knowledge base and contributes to the development of advanced research skills. In contrast, mission-led research is undertaken to address a specific objective.

The Marsden Fund is a relatively small part of the public science system (approximately 4 per cent of expenditure in 2016). Figure 2 (adapted from the NSSI and updated to reflect recent changes to the science system) illustrates how the Fund fits alongside other R&D support mechanisms according to who sets the direction of the research and how funding is allocated.

Figure 2: Government's main expenditures on science and innovation



BERD = business expenditure on research and development
CoREs = Centres of Research Excellence
DoC = Department of Conservation
MBIE = Ministry of Business, Innovation and Employment
MfE = Ministry for the Environment
MPI = Ministry for Primary Industries
NSC = National Science Challenge
PBRF = Performance-Based Research Fund

Figure 2 shows how the Marsden Fund occupies a similar space on these dimensions to the Endeavour Fund (Smart Ideas), Health Research Council (HRC) contestable funds and the Centres of Research Excellence (CoREs). The key distinguishing feature of the Marsden Fund is its freedom from current government socio-economic priorities. Combined with the design principles of being a competitive, investigator-led fund, this allows the Marsden Fund to focus on funding the most excellent research. It appears these characteristics mean the Marsden Fund supports research areas which receive relatively little funding from other New Zealand contestable funds.

2.2 The Minister of Science and Innovation sets the parameters of the Fund

The parameters of the Fund are set by the Minister of Science and Innovation through its Terms of Reference (Annex 4), the Terms of Reference for the Council (Annex 5) and the agreement with the Royal Society to provide executive support to the Council and to act as secretariat for the Fund.

The objectives for the Marsden Fund are as follows.

> **Primary objectives**
>
> Enhance the quality of research in New Zealand by creating increased opportunity to undertake excellent investigator-led research.
>
> Support the advancement of knowledge in New Zealand, and contribute to the global knowledge base.
>
> **Secondary objective**
>
> Contribute to the development of advanced skills in New Zealand, including support for continuing training of post-doctoral level researchers and support for the establishment of early careers of new and emerging researchers.

The Marsden Fund is a competitive investment mechanism whereby proposals are assessed against each other and funds allocated on a project-by-project basis. Competitive funding mechanisms have particular value for investigator-led systems as they can be institutionally neutral and assessed against clear evaluation criteria. They generally have scientific excellence as a primary consideration, and allocation is determined based on some form of peer review. Other examples of competitive funding mechanisms in New Zealand include the Endeavour Fund, the Rutherford Discovery scholarships and the HRC's Explorer and Project grants.

2.3 The Marsden Fund Council oversees the Fund

The Council is made up of up to 11 eminent domestic researchers with responsibility to:

- oversee the assessment of proposals, including developing processes for:
  - contestable assessment
  - peer review of international standard
  - managing conflict of interest and confidentiality
  - inclusion of indirect costs in funding contracts
- recommend proposals to be funded and the amount to be awarded
- oversee the progress of the research funded
- develop 'best practice' policies and procedures for the Fund
- provide advice to the Minister on the performance of the Fund

- communicate the relevance and importance of Marsden-funded research to the New Zealand public.

The Royal Society of New Zealand provides executive support to the Council and acts as secretariat for the Fund, under an agreement with the Minister of Science and Innovation.

2.4 The Marsden Fund Council determines the funding process

The Council determines the funding process and publishes guidelines for the Fund. The Royal Society, as the secretariat, gives effect to the Council's decisions. The Council decides the detailed design of the funding process, including matters such as eligibility criteria, selection criteria, the types of awards (eg Standard and Fast-Start awards), the amounts to be awarded and the amount of funding available to each panel.

Each Council member (except the Chair) convenes one of ten cross-disciplinary panels, which assess applications to the Fund and make recommendations for funding to the Council. The funding available through each panel is set at the start of each funding round based on the volume of applications received by that panel over the last three years.

2.5 The Marsden Fund operates a two-stage process for Fast-Start and Standard awards

Awards are made annually, with initial applications normally in February, full proposals in June and funding decisions in October each year.

The application process involves two stages. At the start of each funding round, Marsden Fund staff from the Royal Society visit research organisations and provide guidance to potential applicants on the application process. Research organisations may encourage applications and help researchers to develop and refine their proposals.

Short proposals are submitted as Expressions of Interest at the first stage to one of the ten panels. Because of the cross-disciplinary nature of the panels, some applicants have a choice of panel to apply to. The panels assess all the proposals. Panellists individually score all proposals from 1 to 6 and rank them; each panellist is instructed to fit the overall distribution of their scores to an approximately normal curve.

The panel then meets face to face to agree scores, rank applications and agree the proposals to be invited to develop full proposals. The final ranking of proposals is by consensus. Deliberations are led by the convenor, and the decision-making process varies from panel to panel. Panellists with conflicts of interest with applicants are excluded from the deliberations for each conflicted proposal. Unsuccessful applicants are advised whether their proposals were ranked in the top 40 per cent of proposals by score. Research organisations may support the development of full proposals; for example, by providing some funding.

Full proposals are sent for peer review to international experts identified by the panel, although it can be difficult and time consuming for the Royal Society to find suitable international peer reviewers for proposals. The applicant can add a rebuttal to address peer reviewers' comments. Panel members assess each full proposal, together with the rebuttal and comments from the reviewers, on a 1–6 scale. The panellists then meet face to face to agree scores and the ranking of proposals. The panel may consider the amount requested and reduce the amount awarded.

3 Literature overview

3.1 Systems for allocating research funding face similar challenges

Because funding is inevitably limited, research funding systems are generally designed to assess research quality and identify those proposals that are likely to generate the greatest expected value (however value is measured). However, the likely quality and impact of research is extremely difficult to judge before it has taken place, and the high demand for funding means time and effort to assess each proposal is limited.

Chubin and Hackett (1990) identified the desirable characteristics of a funding allocation mechanism in the face of this challenge. The mechanism should not only be effective at identifying high-quality research, but should also do so efficiently, ensure accountability, be responsive to changing circumstances, be transparent and readily understood, and use fair processes and reliable measures to compare scientific merit.

3.2 New Zealand research funding systems face particular challenges

The New Zealand science system is relatively efficient, producing a high volume of good-quality academic outputs at a low cost compared to other countries.. Our approaches to solving problems in areas such as biosecurity are world leading. We have internationally recognised strengths in health and biotechnology (MBIE, 2015).

The challenges faced by science funding allocation systems internationally can be exacerbated in small countries such as New Zealand. A small science community creates conflicts of interest that have to be managed, and this can limit the expertise available for impartial evaluation of research proposals (Gluckman, 2012). The potential for conscious and unconscious bias, whether positive or negative, by peer review panels or reviewers is greater in smaller scientific communities (Pouris, 1988).

Limited sources of funding can increase demand for contestable funds, such as the Marsden Fund. The relatively small size of the funds means that the system's capacity for change is greater than for larger countries, but the impact of poor process and mechanisms on the system is greater. Small systems can also suffer from a lack of competition, particularly as research becomes more specialised, and thereby have an effect on the quality of research.

3.3 There are many different models for funding investigator-led research

The Marsden Fund is one of a number of competitive investigator-led funds which exist across the OECD. Not all such funds are government-funded; for example, the Howard Hughes Medical Institute and the Wellcome Trust were created from the estates of wealthy philanthropists. There are a variety of different funding models and allocation systems used. We present some illustrative examples in this section.

3.3.1 Australian Research Council Discovery Programme

The ARC's Discovery Programme focuses on supporting excellent fundamental research to expand Australia's knowledge base and research capability, recognising the importance of

fundamental research to the Australian innovation system (Watt, 2015). It has similar aims and goals as the Marsden Fund.

The ARC Discovery Programme is experiencing declining success rates (the proportion of applications to a fund which receive funding) due to extremely high competition. The process involves one stage only, and full Discovery proposals are generally assessed by two types of assessors: a general assessor, who is normally part of the ARC's College of Experts, and detailed assessors, who perform detailed peer assessment of the proposal. Panels are dynamically drawn from the College of Experts, depending on the portfolio of proposals received in that round.

ARC grant selection criteria include consideration of researchers' business and industry-relevant experience through Research Opportunity and Performance Evidence across all ARC funding mechanisms. ARC selection advisory committees can include members with experience outside academia to support consideration of the broader benefits of proposed research. Success rates are low and declining. Success rates for Discovery projects have declined from 21.4 per cent for funding commencing in 2013 to 17.7 per cent for funding commencing in 2016 (Watt, 2015).

3.3.2 European Research Council

The ERC was established in 2007 with the core aim "to encourage the highest quality research in Europe through competitive funding and to support investigator-initiated frontier research across all fields of research, on the basis of scientific excellence".

The ERC operates two main funding schemes. The first is the ERC Starting Independent Researcher grant scheme, which targets early-career researchers and aims to enable them to transit into the highest echelons of their knowledge communities. The second funding scheme, ERC Advanced Investigator grants, is designed to support stellar scientists and scholars and aims to provide support for highly innovative research ideas at the frontier of the research field in all disciplines. All decisions are made on the basis of peer review, using criteria relating to scientific excellence. Grants can be within a single organisation, or span organisational and national boundaries.

3.3.3 US National Institutes of Health Research Project Grant Program (R01)

The National Institutes of Health (NIH) R01 grant programme supports investigator-led health research. The NIH spent approximately US$10b on the R01 programme in 2014. The R01 programme also has a mechanism for supporting 'new investigators', which it defines as researchers who have not previously received a major NIH independent research award.

The NIH operates a dual peer review system. The first stage is the Scientific Review Group, composed primarily of non-federal scientists with expertise in the relevant scientific disciplines and research areas. The second level of review is by Institute and Center (IC) National Advisory Councils, composed of both scientific and public representatives chosen for their expertise and interest of activity in matters related to health and disease. Both levels must recommend the project for approval before proceeding to the IC director for final funding decisions.

3.3.4 Howard Hughes Medical Institute

The Howard Hughes Medical Institute's (HHMI) Investigator programme supports excellent investigator-led research, but utilises a different funding allocation model. The HHMI is a non-profit medical research organisation, founded by Howard Hughes, and is the second wealthiest philanthropic organisation in the US.

The Investigator programme employs 300 investigators, who must have a PhD or MD, and have between 5 and 15 years' professional experience. Rather than funding research projects, individuals are appointed based on their potential to make significant contributions to science. Awards are made for five years, and researchers are free to explore and modify their research over time. The awards can be renewed after the five-year period. Renewals require documentation of effort after five years, rather than results generated (Ioannidis, 2011).

3.4 Applicant and funder burden is a common issue in funding systems

Competition for grants is increasing and success rates are generally decreasing across many investigator-led research funding allocation mechanisms. A variety of approaches have been suggested and trialled around the world to reduce the burden for applicants and funders as the number of proposals increases.

Some funding bodies operate in-house review teams to perform an initial triage of applications. Common acceptance criteria include procedural factors, such as whether the proposal conforms to the correct format set out by the funding body or whether the applicants meet eligibility criteria. Other considerations may be involved, such as whether the proposed research is in line with the funding strategy. Preliminary in-house triage provides a useful method for reducing the burden on external reviewers, but it can reduce transparency by obscuring the criteria the review team use to whittle down applications (Ismail et al, 2009).

Watt's (2015) review of research policy and funding arrangements in Australia found that some universities were using internal measures to prevent less competitive applications from being submitted to funding organisations. In spite of these measures, there was a trend of rising numbers of submitted proposals which, combined with largely unchanged funding, contributed to falling success rates.

A common suggestion to address the administrative burden in operating a research funding mechanism is to limit the number of applications from an institution. This rule may reduce the burden on the funding mechanism and increase success rates, but simply transfers the burden to the institution. It is not likely to be an effective solution to reduce funder burden because it is difficult to determine the number of applications to accept from institutions, some of which have a broad range of disciplinary research, and because it could reduce the transparency of the funding mechanism and increase the risk of bias in funding decisions.

3.5 Peer review is the cornerstone of research funding systems around the world

Peer review of the quality of research proposals is central to research funding systems worldwide and is the primary mechanism used by the Marsden Fund in selecting proposals.

Peer review-based assessment systems are becoming increasingly studied, as people both within and outside the science sector raise concerns with the peer review model.

RAND Europe found strong support in the literature for the following criticisms of peer review (Ismail et al, 2009):

- It is relatively costly.
- Ratings can vary considerably between reviewers.
- Reviewer anonymity reduces transparency.

RAND Europe found evidence in the literature was mixed for the following criticisms of peer review:

- There is a high bureaucratic burden on individuals.
- It has doubtful long-term sustainability.
- It is anti-innovation and favours conservative research.
- It does not reward interdisciplinary work.
- It does not reward translation/applied research.
- It is gender-biased.
- It is biased by cognitive particularism (where assessors favour proposals aligned with their own school of thought).
- It is open to cronyism.
- It slows down the grant award process.

3.6 A common criticism of the peer review process is the lack of transparency

There is an increasing focus on transparency in science systems internationally, driven by the expanding size of the science enterprise, and an increased expectation of the utilitarian purpose of science to be clear to the public (Gluckman, 2012). RAND Europe's study of the attitudes of UK academics to research assessment found that lack of transparency of the process was a major area of concern (Wooding & Grant, 2003).

Publishing names of members of review panels and peer reviewers after awards have been made, stating the expected impact in research proposals, and publishing the final reports of funded projects have all been suggested as components that could be added to the grant assessment process to increase transparency without adversely affecting the evaluation procedure (Gurwitz et al, 2014).

Another suggestion is publishing successful proposals from the past, along with their reviews, assessment summaries, and final reports to improve transparency, with an embargo period of the release based on when funding commenced (Mietchen, 2014).

3.7 Panels are widely used to assess research proposals but are hard to run well

The assessment of proposals by a panel of peers (a form of peer review) is a component of many international research funding systems. Panels allow those who are most familiar with the subject matter and methodology of research to combine their expertise in judging a research proposal's likely success and contribution to science.

However, as a social process, panel discussions also open up the possibility of a range of individual and group behaviours which may not lead to optimal decision-making.

A number of improvements have been suggested on the composition of panels and their decision-making process to promote open and thorough panel discussions resulting in fair and good-quality outcomes (van Arensbergen et al, 2014):

- Appoint heterogeneous panels; for example, by appointing men and women with different disciplinary and or methodological backgrounds.
- Ensure some overlap of competencies, as this is associated with better cooperation between panellists and allows for open discussion between experts.

- Provide panellists with information on each other's expertise, so they can value their information accordingly.
- Create a situation that supports a sense of collegiality and a good atmosphere during panel meetings.
- Allow deviating opinions and open conflict between reviewers. Panellists with deviating opinions should get the opportunity to explain their opinions and facilitate discussion.

4 Findings

We have looked for evidence of the Marsden Fund's performance in terms of:

- effectiveness at producing excellent research, improving research capability and delivering long-term benefit to New Zealand
- efficiency in the operation of Fund processes.

Some key aspects of the Fund we considered were:

- perceptions of and incentives set by the Fund rules for researchers and institutions
- detailed Fund settings
- governance and strategy
- performance monitoring.

Budget 2016 provided significant additional funding for the Marsden Fund. Therefore we have considered both the Marsden Fund's historic operation, and how the increased funding is likely to affect the effectiveness and efficiency of the Fund.

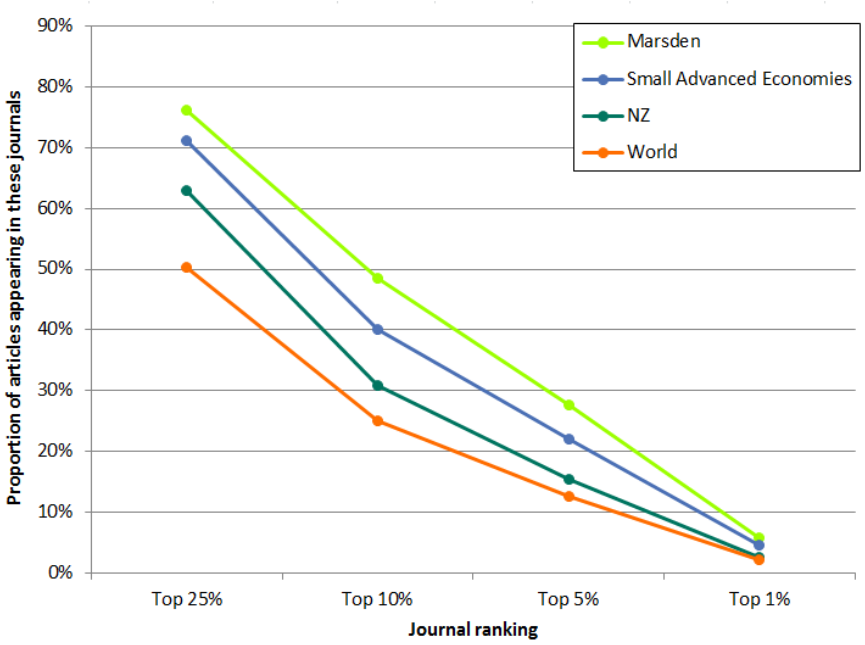
4.1 Research performance of the Marsden Fund

Royal Society data shows the Marsden Fund's important contribution to New Zealand research. Over its 20 years of operation the Marsden Fund has contracted more than 3,000 researchers. The Fast-Start scheme, introduced in 2001, has supported 512 'emerging' researchers (those within seven years of completing their PhD).

Gush et al (2015) found that for research teams, Marsden funding was associated with a subsequent 6–15 per cent increase in publications and a 22–26 per cent increase in citations. For individuals, Marsden funding was associated with a 3–5 per cent increase in annual publications and a 5–8 per cent increase in citations for five years after the award.

Figure 3 shows that articles attributed to Marsden funding outperform the New Zealand average, the small advanced economies, and the world in terms of publication in influential journals. It shows the proportion of articles appearing in the top 1, 5, 10 and 25 per cent highest-ranked journals according to the SCImago journal rank measure of relative citation influence. This shows the Marsden Fund is funding high-quality research.

Figure 3: Performance of publications attributed to Marsden funding (2014–2015)



Source: MBIE calculations based on Royal Society and Scimago Journal Rank data

The Marsden Fund is a major contributor to the internationalisation of New Zealand's public science system, with 57 per cent of Marsden awards having international collaborators at the start of contracts in 2014. This is up from 23 per cent of awards having international collaborators in 1995. Marsden awards allow international collaborators to come on board during the award, with 84 per cent of awards having international collaborators identified in final reports received in 2013–2014, up from 52 per cent reported at the Fund's inception.

4.2 Perceptions of and incentives set by the Marsden Fund

4.2.1 The Fund is highly valued by the science community…

The Marsden Fund is well-regarded by the science community, and obtaining a Marsden award is seen as prestigious. The Royal Society appears to run a strong, efficient administrative process for the Fund, supported by good relationships with researchers and institutions.

Most researchers are relatively comfortable with the application process, although this varies with experience and level of success in the Fund. The two-stage application process is not seen as onerous and the relative stability of Fund processes is highly appreciated.

4.2.2 …but there are concerns about success rates

Common complaints about the Fund are that it has low success rates, that these are low by international standards, and that this is a result of strong competition for too little funding.

In 2015 the Fund received 1,201 preliminary proposals. Of these, 208 progressed to the second stage, with 92 then selected for $53.5m of funding (excl. GST). The overall success rate was 7.7 per cent.

International analysis suggests that the science funding market behaves according to a 'hog cycle', so that increasing funding simply leads to more applications with little change in grant

success rates (Jaffe, 2014). Having reviewed overseas funds, we have concluded that comparing success rates is not particularly meaningful, since different funds have different levels of triage or other methods for managing down application numbers before they are considered true applications for a success rate calculation.

We do not regard a low success rate for applicants as an issue in its own right. However, it is linked with other genuine issues such as high panellist burden and difficulty differentiating between closely matched proposals. The recent Motu study on the Marsden Fund concluded that there is a significant pool of proposals of a similar quality to those that are funded each year (Gush et al, 2015). This is consistent with panellist views that it is very challenging to differentiate between proposals for funding at the second assessment stage due to the high overall quality.

It is not clear whether success rates in the Marsden Fund will increase, decrease or stay the same as funding increases. There are a number of interacting factors, including the expectations of potential applicants about the chance of receiving an award as funding increases, the level of prestige of the Fund (which is linked to lower success rates), and simultaneous changes in the availability of funding elsewhere in the system (eg the HRC funds and Endeavour Fund are also increasing in size). It is reasonable to conclude, however, that the annual increase in funding of over 50 per cent is likely to result in more proposals.

4.2.3 Fund settings may result in excess, lower-quality proposals

Researchers are strongly pushed by their institutions to apply for external research funding. This can either be explicit (eg performance indicators or monetary rewards) or implicit social pressure. For example, the University of Auckland has the application for external research funding as an explicit performance measure for researchers. Only one institution that we spoke to explicitly screens proposals. It saw a marked increase in its success rates after introducing screening, although this does not demonstrate that one caused the other.

The system of allocating funding to panels based on the number of proposals each has received in recent years may drive up the total number of applications. Some researchers spoken to mentioned a strategy of submitting a large volume of applications to increase the amount of funding available in a particular discipline in the longer term.

4.2.4 There is social capital associated with the application process

Our engagements with different institutions and researchers revealed the large amount of social capital involved in the Marsden Fund process.

Institutions that have more interaction with the Marsden Fund, both as sources of applicants and panellists, have a more in-depth understanding of how the process works in practice and seem less sceptical about the quality of the assessment processes and funding decisions. These institutions also tend to have more support mechanisms for applicants, such as coaching by former panel members or awardees. Some institutions run a mock panel process for Marsden Fund applications. Applicants who have had several awards appear confident about how to write a winning proposal and how much time to devote to the application process.

Many unsuccessful applicants we spoke to were unclear about why their proposal had failed at the first stage, and unclear about exactly how panels were appointed and how they assessed proposals. Some associated this with negative perceptions of the Fund, expressing the view that it was a ‘lottery’.

Negative perceptions of the Fund may discourage talented researchers from applying and reduce general goodwill and support for the Fund within the research community. Our findings

suggest these negative perceptions could be countered by improving transparency of assessment processes and building institutional capability to create high-quality research proposals across all researchers.

4.2.5 There is a strong call for better feedback and greater transparency

There is a widespread desire for useful feedback from the Marsden Fund on proposals unsuccessful at the first stage. Currently, the Fund lets researchers in the first stage know whether they scored in the top 40 per cent of proposals or not at the first stage. Both research offices and researchers said this was unhelpful.

Applicants who are unsuccessful in the second stage can ask for detailed feedback from panel convenors and many do so.

Most researchers we spoke to recognised that detailed feedback at the first stage would be difficult and indicated that quintile feedback would be an improvement over the current system.

Better feedback at stage one to both applicants and research organisations could improve the effectiveness and efficiency of the Fund. It would enable researchers and research offices to make better-informed decisions on whether to resubmit proposals in the next funding round, and mean less wasted effort writing and assessing low-quality proposals.

4.2.6 There is some uncertainty about Vision Mātauranga

The Fund asks applicants to consider whether their research project is of relevance to Māori. Where research is relevant to Māori or involves Māori, applicants are asked to explain it in their applications, and this may be taken into consideration in the assessment process. However, it is not an explicit assessment criterion for the Fund. Applicants are advised in guidance materials to seek input from their research offices and be guided by the government's Vision Mātauranga policy in this area.

Our engagement with applicants suggested that researcher understanding of Vision Mātauranga is an area of uncertainty, both in terms of how to address it in proposals and how important it is in the assessment process.

The level of support provided by research offices in this area varies. Some institutions have systematic review panels that involve iwi to make sure Vision Mātauranga is incorporated where appropriate. Some institutions have ad-hoc Vision Mātauranga support.

The level of Vision Mātauranga incorporation seems to vary from panel to panel. Specific examples were given in anthropology and archaeology which demonstrated very strong Māori relevance and involvement.

These findings should be considered in the broader context of ongoing challenges to operationalise and embed the Vision Mātauranga policy across the science system. We suggest it is an area where the Council and the Royal Society should continue to seek improvement. We note the recent changes made by the Council for the 2016 round in this area.

4.2.7 Suggested direction of travel on these issues

We suggest the Council explores forms of feedback which are more useful for applicants and their research institutions. This should be done in conjunction with other funders, including the HRC and MBIE to ensure consistency. Feedback could be accompanied by strong messaging to research organisations to encourage them to develop and submit their strongest

proposals. Any benefits of more extensive feedback for managing demand and improving application quality will need to be balanced against any additional costs of providing it.

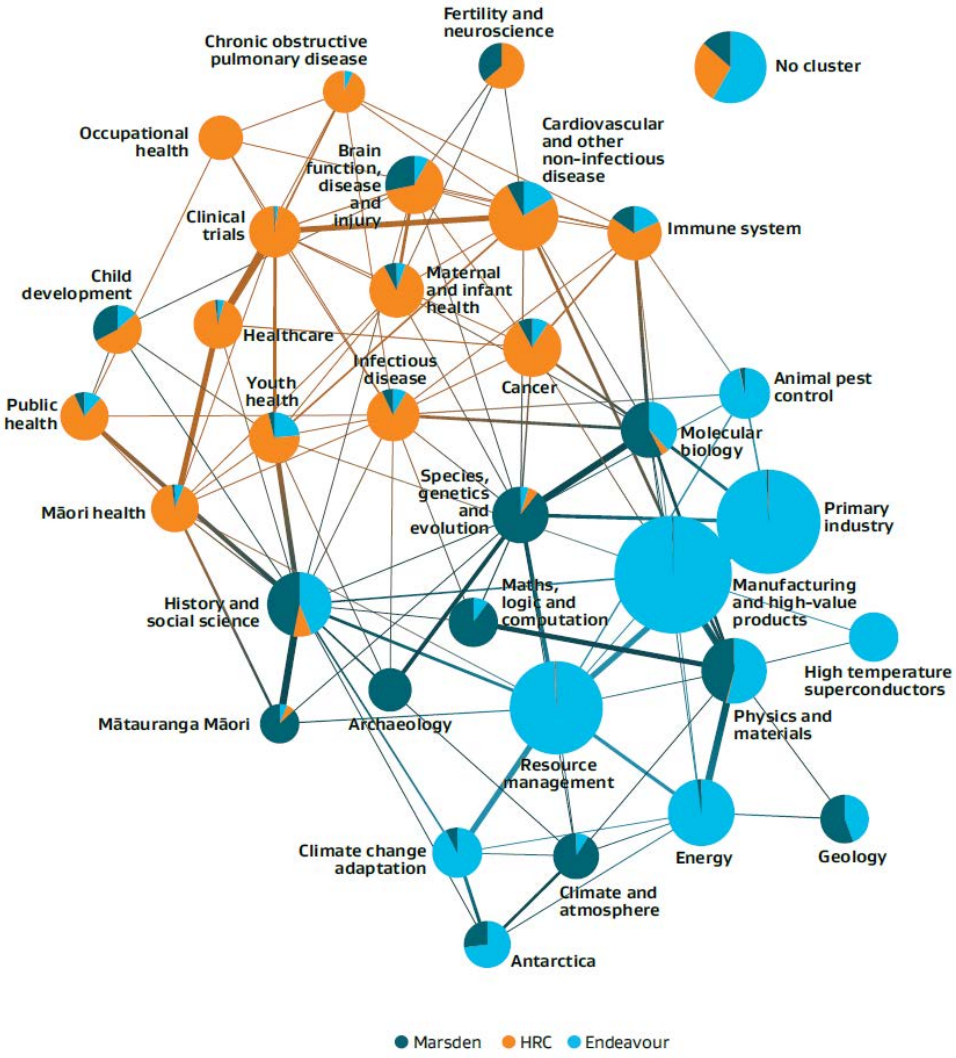
4.3 Alignment with the broader science system and the NSSI

4.3.1 Marsden plays a unique role as part of a broader research funding system

Figure 4 shows a combined semantic analysis of descriptions of the Marsden Fund, Endeavour Fund (and predecessor MBIE funds), and HRC-funded projects between 2008 and 2015 (note: some non-contestable funding is included in here). Circle sizes are roughly proportional to total funding received, and the pie charts indicate the split by funder. It reveals that the Marsden Fund makes particularly large proportional contributions to research funding in mathematics, logic and computation; molecular biology; species, genetics and evolution; archaeology; and climate and atmosphere.

Note: This analysis does not include university research funding not tied to contracts.

Figure 4: Research areas and relationships between Endeavour, Marsden and the HRC for years 2008–2015



Source: MBIE (2016)

The published information on the Fund (eg on the Royal Society website[3]) indicates that it funds science, engineering, mathematics, social sciences and humanities. It also specifies the disciplines that each panel covers. This level of specificity can cause confusion among applicants who may not see their discipline listed and infer that proposals in that discipline are not eligible for funding.

It would be helpful if the Marsden Fund Council made it clear to applicants that the Fund is agnostic about the discipline or field of research (eg in applicant guidance documents and elsewhere as appropriate).

4.3.2 There is some ambiguity about the research horizon considered by the Fund

Our stakeholder interviews revealed that the Marsden Fund is generally considered to be directed mainly at basic or fundamental research. The OECD categorises R&D by research horizon as follows.

> **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular applications or use in view.
>
> **Applied research** is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.
>
> **Experimental development** is systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes.

Basic research, with its primary focus on acquiring new knowledge, is consistent with the focus of the Fund on generating new knowledge. However, both applied research and experimental development also generate new knowledge.

In practice, truly novel research with the potential to profoundly advance knowledge and to attract or retain world-leading scientists is likely to show a strong basic research focus, although this will vary by discipline, with some being naturally more applied in nature (eg engineering, computer science, social sciences).

It would be helpful if the Marsden Fund Council made its expectations about appropriate research horizons for the Fund clearer for applicants.

4.3.3 Objectives and selection criteria are only broadly consistent with the NSSI pillars of excellence and impact

The Fund's nature and objectives as set out in the Terms of Reference are only broadly consistent with the NSSI pillars of excellence and impact:

> The Marsden Fund invests in investigator-initiated research aimed at generating new knowledge, with long-term benefit to New Zealand.
>
> The primary objectives of the Marsden Fund are to:
>
> - enhance the quality of research in New Zealand by creating increased opportunity to undertake excellent investigator-initiated research

[3] http://www.royalsociety.org.nz/programmes/funds/marsden/about/background/

- support the advancement of knowledge in New Zealand contribute to the global knowledge base.

A secondary objective of the Marsden Fund is to contribute to the development of advanced skills in New Zealand, including support for continuing training of post-doctoral level researchers and support for the establishment of early careers of new and emerging researchers.

The selection criteria set out in the Terms of Reference are derived from the objectives of the Fund with only minor wording changes. The current assessment criteria are:

> The Marsden Fund Council will develop and publish selection criteria consistent with the nature and objectives of the Marsden Fund. Primary consideration will be given to:
>
> - the merit of the proposal, including originality, novelty, insight and rigour and the ability of the researchers to carry out the research
> - the potential of the research to contribute to the advancement of knowledge.
>
> Secondary consideration is to be given to ensuring an ongoing supply of top talent through the contribution to the development of research skills in New Zealand, particularly those at the post-doctoral level and emerging researchers.

In practice, the Council has not further developed the selection criteria and uses those set out above.

The selection criteria are not widely understood by researchers. They seem to be too broad and high level to provide practical guidance to either researchers or assessors. Both researchers and research offices seem to have only a high-level understanding of the criteria used to assess proposals, the relative importance of each criterion, and how they are assessed by panels in practice.

Panellists seem to have a clearer understanding of the criteria and how to apply them, but that knowledge is tacit, rather than explicit, so how the criteria are applied in practice also differs between panels. Panel assessment relies heavily on informal processes to interpret and apply the criteria.

Panellists do not appear to explicitly consider the “long-term benefit to New Zealand” specified in the Fund’s Terms of Reference in the assessment of proposals. The “development of research skills” criterion also seems to be considered as an implicit result of engaging in excellent research, rather than as a criterion in its own right. Furthermore, there is no mechanism to moderate scores against the criteria between panels.

Clear, explicit criteria for the assessment of proposals on the basis of excellence and impact can better align the Fund to the NSSI, improve transparency, promote better proposals, support consistent decision-making within and across panels, and enhance confidence that funding will be awarded to the most meritorious research.

We consider it worthwhile to explicitly include an appropriate concept of impact (or potential impact) as a criterion to signal that the government expects benefits from its research investment portfolio. However, we acknowledge it is challenging for some types of investigator-led research to articulate potential impact because research outcomes are highly uncertain, actual pathways to impact may be long and convoluted, and serendipity may play a

role. However, the difficulty of specifying expected impacts does not mean the expected benefits from investigator-led research are not real and substantial (Salter & Martin, 2000).

An impact criterion would need to:

- reflect the investigator-led nature of the research
- be able to reflect the many different dimensions of impact, such as:
  - types of impact (eg economic, social, environmental, cultural)
  - forms of impact (eg new knowledge or information, including that the research did not result in the potential impacts; new techniques, methodologies or instruments; building human capability or networks and attracting international researchers and investment; increasing the ability to solve complex problems)
  - pathways to impact (eg publication, teaching, public engagement, collaboration) that could arise from the research.

4.4 Statistical analysis of Marsden Fund administration data

As a check on the impartiality of the Fund, we undertook a statistical analysis of Fund administrative data from 2005–2015. The analysis identified which variables were significant predictors of scores given to proposals or a proposal's success at stage one or stage two. Neither gender nor ethnicity (ie self-report of Māori descent) of applicants or team members appeared as statistically significant predictors of scores or success of proposals. This reassures us that bias is not present on these factors.

The main predictors of success and scores at both stages one and two are institution and field of research (discipline). Field of research was also found to be a key explanatory variable in the Motu study of the Fund (Gush et al, 2015).

Other less important predictors at different parts of the process are having an international collaborator, larger team size, number of previous proposals made and professional age, although these do not appear consistently across Fast-Start and Standard awards or at stages one and two.

Variation in success under the Fund by institution does not raise concerns – it is to be expected that research quality varies across institutions.

Variations in research quality by discipline are also to be expected and may or may not be an issue. It is difficult to rigorously test whether the variations in scores given to Marsden applications are consistent with the variation in research quality by discipline across the New Zealand research system (as represented by bibliometric indicators, for example). This is because of differences in the way fields of research are coded.

4.5 Assessment panel model

4.5.1 The current panel model works, but could be improved

The Marsden Fund has 10 discipline-based panels which assess proposals for funding. In the second stage, international peer review is also used to inform funding decisions. The number and mix of disciplines included on panels has evolved as the Council has responded to the level of demand. Funding is allocated to panels, in advance of assessment processes, based on the number of proposals received in recent years.

We have identified a number of areas where the current panel model could be improved, which are described below.

4.5.2 Conflicts of interest reduce relevant expertise on panels

The Marsden Fund has rigorous processes for identifying and taking account of conflicts of interest between panellists and applicants. Because the New Zealand research sector is relatively small, conflicts of interest are frequent[4] and are more likely to happen between panellists and applicants in the same field. This means the panellist with the most expertise relevant to a given proposal will sometimes not be allowed to provide their input.

This was a common source of concern among researchers we spoke to. Some researchers feel their proposal has a lower chance of success when there is no 'champion for their proposal' present, and conflicts of interest make this more likely. Publishing the names of panel members before applications are made may discourage applications from disciplines that do not see themselves represented.

This is a source of frustration for applicants, especially in the face of low success rates and repeated unfunded proposals by researchers.

4.5.3 The current panel model may introduce disciplinary bias

Several stakeholder groups have raised concerns that their discipline is disadvantaged by Marsden processes. For example, the Computer Science and Information Systems community and the New Zealand Business Research Deans have both made submissions that their disciplines are disadvantaged versus other disciplines on the panels generally open to them. Both submissions suggest creating new panels to deal with this issue.

The current panel process is susceptible to such issues because the mix of disciplinary representation within a given panel may (arbitrarily) not match the mix of proposals received. Porter and Rossini (1985) found that assessors may rate proposals more closely related to their own discipline more highly. The number of Marsden Fund panels has increased from five to ten since its inception, partly in response to similar, recurring perceptions of bias due to inadequate panel disciplinary coverage.

The current panel process may also discourage interdisciplinary research. Researchers can only apply to one panel, and those we spoke to about this described how they needed to tailor their applications to this end. Some interdisciplinary potential proposals may be put off applying to the Fund altogether due to this issue, and due to the relatively small size of awards (see section 4.6.1). Emerging research fields which sit between current categorisations may also suffer from this issue.

Analysing these effects is challenging. There are many factors which could be at play, such as how the nature of research in these disciplines fits with Fund objectives, and the relative availability of alternate funding sources. It is also almost impossible to know about potential proposals which current settings discouraged from being submitted at all.

The statistical analysis of fund data found that field of research is an important predictor of assessment scores and likelihood of success at stages one and two in the Fund. We know – for example, from bibliometric analysis and Performance-Based Research Fund (PBRF) results – that there are differences in research quality across fields of research in New Zealand's science sector. Unfortunately we cannot test whether the distribution of success under the Fund

[4] The average number of conflicted panellists per proposal ranged from 0 to 1.5 across the different panels, assessment stages and award types in 2015. The (unweighted) mean average across panels was 0.6 conflicted panellists per proposal.

reflects the disciplinary distribution of quality within the science sector, because of differences in the way each discipline is coded in these different data sets.

Although evidence is inconclusive either way, we are concerned that the current panel model risks disadvantaging some disciplines relative to others and discouraging interdisciplinary research proposals. This could materially affect the ability of the Fund to select the highest quality research across disciplines once significantly more funding is available.

4.5.4 There is no moderation between panels

A related issue is that the current panel process includes no explicit mechanism to moderate scores across panels. We recognise that this is a deliberate choice, and that comparing the merit of disparate subjects such as engineering and psychology may be unfeasible. Nonetheless, this problem has been tackled elsewhere, including through bibliometric measures, and the PBRF. Moderation may be possible across a broader span of disciplines than are included in a single current Marsden Fund panel, if not across all disciplines.

By ring-fencing funding based on the previous volumes of proposals received from different disciplines, the current panel model sidesteps the question of comparing merit between unrelated disciplines. However, we consider that the Fund should be aiming to select the most excellent research based on each application's merit, regardless of the discipline.

As with the potential issue of disciplinary bias, the lack of moderation could materially affect the ability of the Fund to select the highest quality research across disciplines once significantly more funding is available.

4.5.5 Burden on assessors is high

Marsden panellists face a high burden. In 2015 an average of 120 preliminary proposals were received per panel, and in general the majority of the approximately 10 panellists on each panel would have read and assessed this number, unless exempted due to a conflict of interest. At stage two, an average of 20 full proposals were considered per panel.

Science funds internationally face challenges in assessing the sheer volume of applications received. Options to address this include performing some form of initial triage of applications either by the funding body or by the submitting research institution.

The approaches adopted by the Marsden Fund which manage high demand include not permitting a primary investigator to hold concurrent awards, having relatively small caps on award size, and gradually increasing the number of panels (from five in 1995 to ten currently). We are concerned that these settings may have been adopted in an incremental fashion, without fully considering their other implications for meeting Fund objectives.

4.5.6 The current panel model appears unsustainable

The current model is unlikely to be sustainable as funding grows considerably towards 2019/20 and the number of proposals and awards increases. Without any change, more panellists per panel, more panels, and/or a higher burden per panellist will be required to consider the likely larger volume of proposals. There is ongoing pressure from the science sector for disciplines that feel they are disadvantaged in the Fund to ask for a new disciplinary panel to be established.

We do not consider more panels to be desirable, since this fragmentation will exacerbate the existing issue of lack of moderation between panels, the risk of unintended bias against particular disciplines, and inflexibility to invest in the most excellent proposals across all disciplines. It will also increase operational costs due to logistics etc. We believe it may be

possible to introduce a more efficient panel structure and panel processes which mean panellist-hours are spent where they can add the most value to assessment.

4.5.7 Suggested directions of travel on these issues

Consider alternative methods to the panel structure and appointment

It would be worthwhile exploring alternative panel models and gathering evidence on their effectiveness at dealing with the potential issues and risks discussed above and relating to:

- impact of conflicts of interest on expert availability
- risk and perceptions of disciplinary bias
- moderation between panels
- support for research in interdisciplinary and emerging research fields
- burden on assessors
- increasing fragmentation of panels.

We suggest the Council assesses the long-term sustainability of the current panel structure and some alternative options for their ability to address these issues and meet the Fund objectives cost-effectively in the New Zealand contest.

We have suggested some alternative panel models below with features we consider could be beneficial for the Fund. This is not an exhaustive list of possibilities and we encourage the Council to explore a broad range of options.

Subsets of panels assess proposals

We recommend the Council investigates assigning proposals to a subset of the panel in the first stage to ease the burden on panellists. This subset could be made up of the relevant subject matter experts on the panel (or the best fit) and some non-subject matter panellists to provide an outside and general perspective on the proposal. We note that this practice is employed in other funds (such as the Endeavour Fund) where application numbers are high.

Demand-driven panels

Currently panels cover the same disciplines from year to year and panellists are appointed before the first-stage proposals are received by the Royal Society. This has some operational benefits (eg there is less time pressure to recruit panellists), but also potential downsides as described above.

We recommend investigating the option of appointing panels *after* first-stage proposals are received. This could be achieved by maintaining a standing body of expertise to draw upon to find panellists. We note that the HRC already has demand-driven panels for some of its funds. It would also be worthwhile for the Council to consider sharing access to panels used by other funds such as the ARC, the HRC and the Endeavour Fund.

A smaller number of broader panels

A smaller number of panels, each covering a broader range of disciplines than current panels, could help to provide a more robust and flexible approach to changing demand and provide greater comparability between proposals. We have estimated that four of the current panels cover 80 per cent of the Field of Research coding of Fund proposals.

4.6 Size and diversity of awards

4.6.1 Awards are too small

The spending power of Fast-Start and Standard awards has remained flat in real terms (ie after adjusting for inflation) since 2008. After the 10 per cent increase for the 2017 funding round, the Standard Marsden awards are now capped at $660k–$960k over three years. Researchers we spoke to note that this places a significant constraint on the scale of research that can be carried out. Post-doctoral fellows are generally too expensive to include in proposals, so substantial work must be done by post-graduate students who require supervision.

Research costs vary by discipline, so the relatively small awards will constrain some disciplines more than others.

There is international evidence that research by larger teams, with interdisciplinary and international collaboration, has greater citation impact (Larivière et al, 2015; Tang, 2011). With current Marsden award sizes it is not feasible to fund significant interdisciplinary research, nor teams with much more than one-third of a principal investigator's time.

A recent analysis by the Royal Society of field of research combinations across 7,793 proposals between 2009 and 2015, analogous to that performed for the ARC funding by Bromham et al (2016), found no evidence that proposals with a greater 'interdisciplinary distance' had lower success rates in the Marsden Fund. Nonetheless, it is highly plausible that larger, interdisciplinary proposals are not submitted because the investigators think the proposal would be unfeasible under current funding caps. Such proposals would require a significant amount of two or more principal investigators' time.

We consider there is opportunity to increase the impact of Marsden research by giving flexibility to fund a mix of larger and smaller projects to allow greater levels of interdisciplinary and international collaboration than the current Standard award.

The awards for interdisciplinary research would need to be designed to:

- be commensurate in award size with the Standard Marsden awards (typically part of a principal investigator's time and an associate investigator)
- be limited in number so that they do not erode the availability of Standard awards
- complement and not substitute for other funding mechanisms for interdisciplinary research, such as the National Science Challenges.

4.6.2 Rules disallow reinvesting in successes

Current Fund settings constrain it from directing significant additional investment into projects and researchers with proven success. Some researchers we spoke to spoke of having to 're-package' research proposals to demonstrate novelty, since they did not expect to be successful if proposals were an obvious continuation of previous Marsden-funded work.

Researchers are not allowed to hold concurrent awards as the primary investigator and, if submitting for a new Marsden award, must demonstrate novelty rather than continuing previous work.

Although novelty is a crucial aspect of Marsden research, it brings significant upside and downside risks. One way of reducing risk when investing is to take into account the outcome of previous investments as a guide to future performance. All projects and researchers chosen for funding promise excellent research, but they will differ considerably after three years in how much of this promise is delivered and how much potential there is for impact on their field through further work.

4.6.3 There is a trade-off between breadth, depth and novelty of funded research

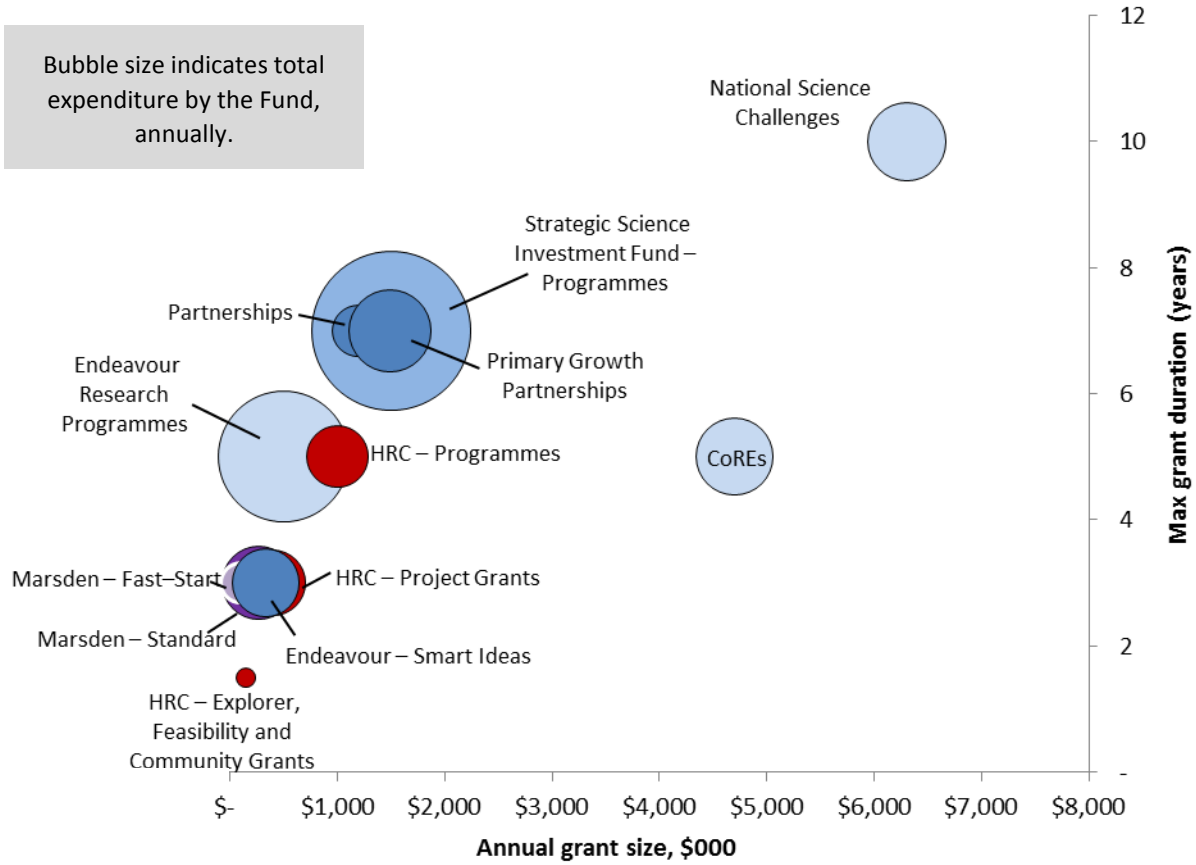
There is a trade-off between concentrating more investment on projects and researchers with proven success and funding a broad range of disciplines and researchers. Directing more investment to larger or longer projects means successful research receives ongoing funding, but this could be at the expense of generating fresh ideas and talent from a more diverse selection of researchers, including younger researchers.

We note that the Marsden Fund used to have a renewal mechanism that was discontinued. Additional funding provides an opportunity to revisit this decision.

If adopted, we suggest the Council takes an explicit, strategic approach to manage the desired trade-off between more concentrated investment in successes versus supporting diversity and novelty within the portfolio of awards. This approach should be guided by the Fund objectives and refined based on evidence from performance monitoring.

Figure 5 illustrates how the Marsden Fund is placed alongside other key science and innovation funding mechanisms in New Zealand. This shows that the Fund makes a substantial contribution in the small project space, as well as supporting emerging researchers. It is important that any marginal shift to include larger and/or longer projects under the Fund does not erode this important contribution to the dynamism and breadth of the funding landscape.

Figure 5: Award size, duration and total size of key New Zealand Science and Innovation funding mechanisms



4.6.4 Suggested direction of travel on these issues

Increase the size of existing awards to reflect the costs of performing research

The increase in funding provides the opportunity to increase the cap on existing awards to ensure that they are of a sufficient size to undertake excellent research that maximises long-term benefit to New Zealand. We note that the Council has increased caps uniformly by 10 per cent for the 2017 funding round. We have estimated that this 10 per cent increase adjusts for inflation since hard caps were introduced in 2012, so does not represent a significant increase in real terms.

We consider that there is insufficient justification as to why the caps are set at current levels. In light of significant additional investment in the Fund, we consider that there is an opportunity for the Fund to better reflect the cost of research across various disciplines. As part of the Investment Plan process we recommend the Council investigate the real costs of performing research across different disciplines to develop a robust evidence base to allow the Council to make decisions around setting the funding caps. We note that the PBRF funding formula takes account of the relative cost of research in three broad disciplinary categories.

Consider different award sizes

The increase in funding allows scope for some larger awards to be awarded (in addition to Standard and Fast-Start), particularly where research is required at a larger scale for excellence and impact. This could be the case, for example, in interdisciplinary research. This is in line with the Council's response to the NSSI.[5]

These awards would need to be designed to be commensurate in award size with the Standard Marsden awards, be limited in number so that they do not erode the availability of Standard awards, and complement, not substitute for, other funding mechanisms for interdisciplinary research, such as the National Science Challenges.

Additionally, feedback from researchers (both from our focus groups, and from various submissions received) suggested support for a small award category (ie $50k–$100k). We consider this worth investigating, but consideration would have to be given on how this would contribute to the Fund's purpose and stated objectives. We encourage the Council to investigate this as part of the Investment Plan process.

A small award category, if appropriately designed, may reduce the number of applicants for Fast-Start and Standard awards, and may better serve some disciplines that require smaller amounts of funding. The Fund currently sets a strong incentive to apply for the maximum amount of funding in order to maximise return due to low probability of success.

Consider a mechanism for reinvesting in success

The current three-year funding period of some research may not be sufficient to develop the full potential of some awards. The increase in funding allows scope for the renewal of some awards that show particular promise. An explicit renewal process would help to address the current practice whereby previous award holders applying to the Fund need to re-frame proposals as completely novel in order to get funded, whereas in reality they continue work being undertaken under previous awards.

[5] http://royalsociety.org.nz/2015/11/03/marsden-fund-council-response-to-nssi/

We note that a two-year extension mechanism for awards used to be in place (2003–2008). As part of the Investment Plan process, we recommend the Council assess how such a mechanism could contribute to fund objectives.

4.7 Overall governance and strategy of the Fund

4.7.1 There is limited visibility of the rationale for detailed fund settings

The Council's role includes developing best practice policies and procedures to implement the Terms of Reference for the Marsden Fund. This includes:

- the panel model used
- the size and duration of awards
- the ability to hold concurrent awards or extend awards
- the balance of funding by award type (ie Fast-Starts and Standard Grants).

The Council considers these decisions carefully and receives good data support from the Royal Society for these discussions. We consider that the visibility (to both government and the science sector) of the rationale for decision-making by the Council is an area for improvement.

This visibility issue has become apparent as the Assessment has identified the various issues with Fund processes described above. Suggested approaches to tackling these issues are made in this report. A mechanism will also need to be put in place to demonstrate that Fund design decisions are being made with a clear line of sight to Fund objectives on an ongoing basis. This is especially important as the Fund grows in size and the demands on its processes change.

4.7.2 Government needs ongoing independent assurance that the Fund is working

The basis for the Fund's decision-making is peer review. The literature acknowledges that peer review has some shortcomings, including the potential for conscious or unconscious bias, especially in small communities such as New Zealand. However, it remains the best option for assessing scientific excellence, especially when assessing cutting-edge science prospectively (ie before any results and where the knowledge is particularly specialised).

The current Fund processes include international peer review at the second stage and some Australian experts on assessment panels. However, the process by which panel convenors choose panellists is relatively informal and undocumented. We consider there is scope to increase the level of international peer assessors, on panels and in periodic reviews of overall Fund performance.

This would provide an additional check on the quality of funded research. It would considerably improve assurance for government by reducing the risk of unconscious or conscious bias (notwithstanding existing conflict of interest procedures) and by accessing more expertise from those working at the global cutting-edge.

4.7.3 Formal governance arrangements may need clarifying

The independence of the Fund from the government of the day's socioeconomic objectives underpins its credibility and is important to maintain and signal through governance arrangements.

Under current governance arrangements, the Council cannot make final funding decisions as it is not a statutory body under the Research, Science, and Technology Act 2010. The Royal Society therefore formally makes these decisions, on the advice of the Council, with which it "shall normally agree" (according to the Fund Terms of Reference). The intent is to make the

Marsden Fund Council the decision-maker, with the involvement of the Royal Society in this part of the process being only for practical considerations.

There is an opportunity to revise the Fund and Council Terms of Reference and create an Investment Plan detailing the Council's decisions on the funding process and how they fulfil the objectives of the Terms of Reference. This could clarify existing, respective roles and responsibilities of the Council, Royal Society, MBIE and the Minister of Science and Innovation in determining settings for the Fund. It would not affect the role of the Council in making funding recommendations, which is explicitly outside the scope of this Assessment.

4.8 Performance monitoring and evaluation

Current performance monitoring includes contract reporting, site visits, voluntary output reporting post-awards, and case studies of the results of a small fraction of projects. The results collected are used, along with administrative data, in reporting by the Royal Society, to demonstrate some of what the Fund has achieved. Site visits are seen as a unique feature of the Marsden Fund in the New Zealand science funding landscape, and there is strong stakeholder support for these.

This level of reporting is not sufficient to inform whether the overall investment portfolio (or parts of it) are delivering on the Fund objectives; that is, it is not systematically assessed whether Project X or the overall investment portfolio actually delivered excellent research.

As a result, current performance monitoring cannot properly:

- inform fund operational decisions to provide the visibility and rationale sought by the government
- inform reinvestment decisions by systematically identifying successful projects in the portfolio
- demonstrate to government the value of its investments and provide justification for increasing funding.

The results of funded research are often not known until the contract has terminated. Some outputs are published after the contact has finished, and the research impact of outputs is not known for several years. On average, citations peak seven years after publication. In addition, the effect of Marsden funding that supports new and emerging researchers is often not known until several or many years after the award. Following the careers and assessing the outputs of researchers receiving Marsden awards is required on a systematic basis. Open Researcher and Contributor ID (ORCID) identifiers provide the underpinning data infrastructure to enable this.[6]

More comprehensive and in-depth monitoring and evaluation would need to cover not only contract monitoring and reporting but also process evaluation and *ex post* impact evaluation. Quantitative impact assessment can be challenging for investigator-led research that has long-term effects, and should be complemented by expert review to assess the excellence and impact of the research (eg advancing the understanding of the field).

[6] Further information on ORCID can be found at: http://www.mbie.govt.nz/info-services/science-innovation/data-and-information-improvement/orcid

5 Recommendations

Our recommendations are intended to place the Marsden Fund in good stead to continue to invest in excellent investigator-led research into the future. They:

- reinforce the position of the Fund as the government's foremost vehicle for investing in investigator-led research
- align the Fund with the NSSI's twin pillars of excellence and impact
- strengthen the role of the Marsden Fund Council in setting the strategy for and managing the Fund
- maintain the stability of the Fund's processes for applicants
- enhance the ability of the Fund to respond effectively to change and remain scalable, robust and fit-for-purpose into the future
- increase the transparency and accountability of the Fund
- expand the international expertise available for the governance, management and monitoring of the Fund.

The recommendations cover the key factors that together contribute to confidence that the Fund will invest in excellent research with long-term benefits for New Zealand: governance; strategy and management; and monitoring and performance.

5.1 Governance

Recommendation 1: Strengthen the Marsden Fund Council

We recommend appointing researchers from outside New Zealand to the Council to expand the expertise and experience available for the governance and management of the Fund.

International experts would provide a strong independent voice on the Council as they would not be eligible for Marsden funding or hold positions at domestic research institutions. They would bring different perspectives and experiences to the Council, including experience of international funding bodies, as well as facilitate greater international connectivity for the Fund.

They would be subject to the same eligibility rules as domestic researchers, and could not be international collaborators on Marsden Fund projects. We consider that the benefits of having international experts on the Council outweigh the potential costs, especially if the international members are not also panel convenors.

The Council will have an explicit role in developing a clear strategic direction for the Fund through an Investment Plan (see recommendation 2) and will need to have a greater range of skills than currently.

If this and other recommendations in this report are implemented, it may no longer be practical or necessary for every councillor to also be a panel convenor and thus make it more feasible to have overseas Council members. For example, councillors may have more diverse skill-sets, some may be based overseas, and a different panel model with fewer panels may be adopted.

Given the potential to decouple the panel convenor and councillor role, there is an opportunity to appoint some councillors with more emphasis on governance skills and experience of designing and running large-scale science funding mechanisms. Formal governance training is

also an option for increasing the capability of Council members, where this is seen as necessary.

5.2 Investment strategy and management

Recommendation 2: Develop an Investment Plan that lays out the Fund's strategic direction with respect to its objectives

The Investment Plan would be similar to those recently developed for the Endeavour Fund and the Strategic Science Investment Fund. It would be developed by the Council and agreed by the Minister of Science and Innovation, be renewed periodically, and be subject to minor annual adjustments to keep it up to date.

The Investment Plan would set out the strategic direction of the Fund, including how the Fund will be managed to achieve its objectives and contribute to the NSSI vision and goals. It would include decisions or policy on detailed fund settings; signal the Council's intent for the size, number and type of awards over the next three years; and provide a timetable of changes stemming from this report.

The Investment Plan should include proposals or plans to address the issues raised in this report (in the context of achieving the Fund's objectives), including:

- feedback for fund applicants
- impact of conflicts of interest on expert assessor availability
- risk and perceptions of disciplinary bias
- moderation between panels
- support for research in interdisciplinary and emerging research fields
- burden on assessors
- fragmentation of panels
- the size of awards
- reinvestment in promising research.

In addressing these issues, the Council should consider the possible directions of travel for the Fund suggested in sections 4.2.7, 4.5.7 and 4.6.4 of this report. We expect that any Fund changes would have a clear rationale, and we encourage the Council to obtain robust evidence to support any changes and collect data to evaluate their impact.

Recommendation 3: Align Fund objectives with the National Statement of Science Investment

Through the Investment Plan process, the primary Fund objectives should be updated to reflect the twin pillars of the NSSI: excellence and impact. The objectives should reflect the pillars in the context of the Fund's purpose: funding excellent, investigator-led research. We also suggest updating the terminology of the Fund's purpose for consistency.

The primary Fund objective should be updated to include an explicit concept of impact (or potential impact). This concept needs to be well articulated and appropriate for the purpose of the Marsden Fund. The objectives of the Fund are a good vehicle for the Council to communicate its view of the role of the Marsden Fund in the wider New Zealand research funding landscape.

Recommendation 4: Improve the transparency of assessment processes for applicants

Assessment of proposals needs well-documented processes which are fair, transparent and defensible when scrutinised. Clear processes will improve perceptions of the Fund by the sector and increase assurance for government.

We recommend the Council works to develop and clarify the following areas in particular through the Investment Plan and/or other communication channels.

- **Assessment criteria:**
  There should be explicit assessment criteria aligned with the (updated) Fund objectives and the NSSI pillars of excellence and impact, and appropriate for investigator-led research across a range of disciplines. Current criteria are open to interpretation, and we believe their meaning could be better conveyed without making them overly prescriptive. Some concept of impact will need to be incorporated to align with the revised Fund objectives.
- **Assessment processes:**
  Assessment criteria should be accompanied by clear guidance to applicants on what factors assessors take into account when judging a proposal, and descriptions of the processes followed by panels in making their judgements.
- **Panellist appointments:**
  Panellist appointment is not well understood by research institutions and researchers. There are some negative perceptions, particularly for institutions with less Marsden success. We recommend the Council assess how the transparency and operation of panel appointment processes could be improved to manage potential conflicts of interest while providing the expertise for assessment.

5.3 Monitoring and performance

Recommendation 5: Develop a performance framework for the Marsden Fund

We recommend the Council develops a performance framework for the Fund suitable for investigator-led research with long-term impact across a wide range of disciplines.

A performance framework would provide a consistent and coherent way to monitor the performance of the Fund and funded research against the strategy set out in the Investment Plan. Data collected through the framework could inform decisions to re-invest in projects, provide a feedback loop into the effectiveness of the Fund settings, and provide evidence on the long-term impact and value of the Fund.

The performance framework should include not only contract monitoring and reporting but also process evaluation and *ex post* impact evaluation. It should also include expert review as an integral part of the assessment process (see recommendation 6).

Recommendation 6: Appoint an international review board to periodically evaluate the Marsden Fund's performance

We recommend the Minister of Science and Innovation appoints an international review board every three years. The board should comprise eminent world-class experts from outside New Zealand and undertake assessments of the substance, excellence and impact of research funded by the Fund. The board would be guided by a Terms of Reference prepared by the Minister.

This review board would report to the Council with its findings. The Council would then report to the Minister with the findings from this review, and a view as to how to address any issues found.

5.4 Implementation

Recommendation 7: The Council should play a key role in implementing the recommendations of this report

The Council is well placed to implement the report recommendations on Investment Strategy and Management, and Monitoring and Performance (recommendations 2–6) as part of its strengthened role. This includes testing and developing further, where appropriate, directions of travel suggested in the report.

Implementation should be phased and communicated so as to minimise disruption and uncertainty for the sector. Implementation should be done in consultation with MBIE and with administrative and analytical support from the Royal Society.

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Annex 1: Terms of Reference for the Assessment of Strategy and Management, 2016

Marsden Fund

Assessment of Strategy and Management, 2016

Terms of Reference

Context

1. The Marsden Fund (the Fund), established in 1995, invests in excellent investigator-led research. The Royal Society of New Zealand provides executive support to the Fund on behalf of the Marsden Fund Council. The Marsden Fund Council is appointed by the Minister of Science and Innovation.
2. The Fund received $54m in government funding in 2015. Through Budget 2016, government has committed significant additional funding to the Fund.
3. The administration of the Fund is governed by its Terms of Reference, which state that:
    - the Fund invests in investigator-initiated research aimed at generating new knowledge, with long-term benefit to New Zealand
    - the Fund supports excellent research projects that advance and expand the knowledge base and contribute to the development of people with advanced skills in New Zealand
    - the Fund encourages New Zealand's leading researchers to explore new ideas that may not be funded through other funding streams, and fosters creativity and innovation within the research, science and technology system.
    - the research is not subject to government's socio-economic priorities.
4. The National Statement of Science Investment (NSSI) sets out the government's strategic direction for investment in research, including investigator-led research. It is based on two key pillars: excellence[7] and impact[8]. It acknowledges the importance of investigator-led research in generating ideas, expanding the knowledge base, and contributing to the development of advanced research skills; confirms the role of the government as its primary funder because its nature means it is unlikely to be funded otherwise; and commits to focusing a greater proportion of additional public investment in this area over time.

Purpose

5. The Minister of Science and Innovation has requested officials to provide advice on how to maximise the long-term benefit to New Zealand from continued investment in investigator-led research through the Fund.

[7] Excellence – see page 13 of the *National Statement of Science Investment 2015–2025*.

[8] Impact – see page 11 of the *National Statement of Science Investment 2015–2025*.

6. The advice will be provided to the Minister following the Marsden Fund Assessment of Strategy and Management (the Assessment) to:

    - provide ongoing assurance of the benefit of government investment in the Fund, particularly in light of the additional investment made in Budget 2016
    - ensure the Fund is making robust, fit-for-purpose investments in excellent investigator-led research with long-term benefit to New Zealand.

Key drivers

7. The following are key drivers for the Assessment:

    - The 'business as usual' policy cycle – in particular, the desire for ongoing assurance of the value for money of government investment, particularly in light of the additional investment made in Budget 2016.
    - Given the Fund's broad subject focus, assurance that the Fund's strategy and management does not give undue weight to particular fields of science and research and does not create various forms of bias.
    - Whether the current selection process is the most robust way of ensuring that only excellent research is funded, and delivers on the Fund's goal of investing in investigator-led research aimed at generating new knowledge that delivers long-term benefit to New Zealand. In particular, how the Fund ensures that different fields of research are treated in an unbiased fashion across panels.
    - The changing nature of research; for example, the emergence of big data, the need for trans- and inter-disciplinary research, and the emergence of new disciplines.
    - The rising focus in many countries of developing ways to improve the processes and approaches to peer review and funding allocations.
    - The NSSI's key pillar of impact, and the extent to which this is being considered in selection, monitoring and follow-up. In considering impact, we do not wish to shift the overall focus of Marsden to a more mission-led orientation. It will remain investigator-led and not driven by specified impacts. However, we want to ensure that management of the Fund contributes appropriately to the NSSI goal of "comprehensive evaluation and monitoring of performance, underpinned by easily available, reliable data on the science system", and that identifying impact as well as excellence is considered as part of the ongoing evaluation and monitoring of funded proposals.
    - The international positioning of the Fund, and the need to ensure that both the operation of the Fund and the projects funded are making an appropriate contribution to the NSSI goal of "continuous improvement in New Zealand's international standing as a high-quality R&D destination".
    - The NSSI also requires that public investment in research be subject to comprehensive evaluation and monitoring of performance, underpinned by easily available, reliable data on the science system.

8. The Assessment will seek to reach conclusions on the extent to which the issues noted above may suggest modifications to the Fund's mode of operation.

Out of scope

9. The following factors are outside the scope of the Assessment:

    - the fundamental nature of the Fund as a funder of investigator-led discovery science and research in New Zealand
    - the role of the Marsden Fund Council in making funding recommendations for the Fund
    - the role of the Royal Society of New Zealand as the provider of executive support for the Fund
    - the size of the Fund.

Scope

10. The Assessment of the Fund will address the following issues of strategy and management, with a particular focus on investment processes over the last five years.

    Investment strategy for the Fund

    - the nature of the research funded in the investment portfolio
    - the balance of research across the investment portfolio
    - the mechanisms that determine the structure and balance of the overall investment portfolio
    - the size of research investments
    - the mechanisms that determine the size of research investments.

    Management of the Fund

    The operational processes for managing the Fund, including:

    - the overall process
    - call for research proposals
    - determination of selection criteria
    - allocation of proposals to panels
    - selection and membership of review panels (particularly the issue of conscious and unconscious bias in panels)
    - the selection process and whether it might lead to particular fields of research being favoured
    - management of conflicts of interest and any other potential biases in review panels
    - application of selection criteria
    - the peer review process
    - feedback processes on proposals
    - selection of proposals
    - contracting, including key performance indicators
    - monitoring, reporting and feedback on performance of individual contracts
    - collection, dissemination and analysis of performance information
    - assessment of impact of individual contracts
    - assessment of the impact of the overall investment portfolio
    - communication to the science sector and the public.

Key questions to be addressed

11. The Assessment will address key questions, including:

    - How, and to what extent, does the Fund's overall portfolio of research investment contribute to new knowledge and other outputs that generate long-term benefit to New Zealand?
    - Is the Fund's overall investment strategy fit-for-purpose, efficient and effective in terms of producing excellent research, improving research capability and delivering long-term benefit to New Zealand?
    - How, and to what extent, does the strategy and management of the Fund (eg composition of review panels) affect the investment portfolio?
    - How, and to what extent, does the structure and balance of the Fund's investment portfolio (eg by size of investment and area of research) contribute to excellent research, improving research capability and long-term benefit to New Zealand?
    - What is the Fund's influence on the behaviour and performance of the academic community and the tertiary sector, and on New Zealand's international standing?
    - Is the Fund providing knowledge of value to New Zealand in domains not being addressed through other mechanisms?
    - How does the Fund's overall investment strategy and management support the themes of Vision Mātauranga?
    - Is management of the Fund fit-for-purpose, efficient and effective in terms of producing excellent research, improving research capability and delivering long-term benefit to New Zealand?
    - How does the overall investment strategy and management of the Fund affect the behaviour of applicants (eg in number, nature, size and composition of proposals) or of reviewers? Are there unintended or perverse incentives, and if so, how are they manifested and how can they be mitigated?
    - Is the monitoring and reporting of individual contracts efficient, effective and fit-for-purpose? Is the collection, dissemination and analysis of performance information appropriate and fit-for-purpose?
    - How can the Fund's overall investment strategy and management be improved to generate long-term benefit to New Zealand?

Method

12. The Assessment will be conducted by the Ministry of Business, Innovation and Employment (MBIE).

13. The Assessment will include interviews with key stakeholders (eg Council members, funding panel members, departmental science advisors, institutions, researchers and grant recipients).

14. The Marsden Fund Council and the Royal Society of New Zealand will also be interviewed and engaged at regular points during the process. They may choose to consult members or interested parties if appropriate, but should agree the mode and timing of such consultation with MBIE prior to doing so.

15. The Assessment will review relevant literature and material on investigator-led research in general and on the Fund (eg contracts, Gazette notices, Terms of Reference, and Marsden Fund Impact Reports).

16. The Assessment will include comparisons with other investigator-led funding mechanisms in other jurisdictions (eg European Research Council, Australian Research Council and

National Science Foundation) and the analysis of data and other information held by MBIE or the Marsden Fund Council. Novel data collection will be limited to consultation with key stakeholders.

17. Public submissions will not be invited. Stakeholders may make written submissions to MBIE if they consider it appropriate.

Planning and implementation arrangements

18. MBIE will lead the project. A reference group, comprising senior officials, will meet on a monthly basis to ensure effective oversight of the project.
19. MBIE will report to the Minister of Science and Innovation by 1 October 2016 with a detailed report, which will include, if necessary, a set of recommendations aimed at improvement.
20. The Royal Society of New Zealand and the Marsden Fund Council will have the opportunity to review the report, provide feedback, and correct any matters of factual inaccuracy prior to the report being submitted to the Minister.

Annex 2: Stakeholders interviewed

Universities

At each university we held two meetings, one with a group of researchers selected by the university, and the other with members of the Research Office.

University of Auckland

Name	Position
Professor Donna Rosa Addis	Professor – Psychology
John Taylor	Senior Lecturer Biological Sciences
Professor Christine Arkinstall	Associate Dean Research – Faculty of Arts
Dr Charles Unsworth	Senior Lecturer – Engineering Science
Associate Professor Mark Vickers	Associate Director, Academic
Dr Megan Barclay	Postdoctoral Research Fellow – Physiology
Jing Liu	Research Office
Eszter Muradin	Research Office
Christina Zhang	Research Office
Lina Gonzalez	Research Office
Wendy Rhodes	Research Office
Denise Greenwood	Research Office
Karen Gregory	Research Office

Auckland University of Technology

Name	Position
Dr Peter Skilling	Senior Lecturer – Management
Professor Jeffrey Hunter	Professor – Mathematics
Professor Andrea Alfaro	Professor – Marine Ecology and Aquaculture
Catherine Redmond	Research Office
Liana de Jong	Research Office
Sophie Moore	Research Office
Allison Maplesden	Research Office

Canterbury University

Name	Position
Professor Jarg Pettinga	Acting Deputy Vice-Chancellor Research (DVCR)
Dr Renwick Dobson	Lecturer – Biochemistry & Principal Investigator at Biomolecular Interaction Centre
Professor Simon Brown	Professor – Physics
Professor Matthew Turnbull	Professor – Biological Sciences

Professor Steven Ratuva	Professor – Sociology & Director of Macmillan Brown Centre for Pacific Studies
Associate Professor Jenni Adams	Associate Professor – Physics and Astronomy
Professor Charles Semple	Professor – Mathematics and Statistics
Maxine Bryant	Research Office
Lisa Shorey	Research Office
Jace Carson	Research Office
Christine van Hoffen	Research Office
Nigel Harris	Research Office

Victoria University of Wellington

Name	Position
Professor Phil Lester	Professor – Biological Sciences
Dr Maria Bragh	Senior Lecturer – Head of Māori Studies
Professor Charlotte McDonald	Professor – School of History, Philosophy, Political Science and International Relations
Professor Sue Schenk	Professor – Psychology
Professor Mengjie Zhang	Professor – Computer Science
Dr Janet Pitman	School of Biological Sciences
Associate Professor John Townend	Head of School of Geography, Environment and Earth Sciences
Ian Mctosh	Research Office
Mireille Consalvey	Research Office
Gywn Williams	Research Office
Jeannette Vine	Research Office

Lincoln University

Name	Position
Professor Philip Hulme	Professor, Bio-Protection Research Centre
Dr Artemio Mendosa	Research Officer, Bio-Protection Research Centre
Dr William Godsoe	Bio-Protection Research Centre
Dr Amanda Black	Lecturer, Bio-Protection Research Centre
Professor Travis Glare	Professor, Bio-Protection Research Centre
Dr Johanna Steyaert	Research Officer, Bio-Protection Research Centre
Professor Brian Jordan	Professor, Faculty of Agriculture and Life Sciences
Associate Professor Adrian Paterson	Associate Professor, Faculty of Agriculture and Life Sciences
Dr Michael McKay	Lecturer, Environment Society & Design
Professor David Simmons	Professor, Tourism Studies
Elizabeth Hopkins	Research Office
Carolyn Mander	Research Office

University of Otago

Name	Position
Professor Richard Blaikie	DVCR
Professor Michael Winikoff	Professor – Head of Department of Information Science
Associate Professor James Maclaurin	Associate Professor – Philosopher
Professor Peter Dearden	Professor – Biochemistry
Professor Jeff Miller	Professor – Psychology
Professor Jon Waters	Professor – Zoology
Dr Lise Te Morenga	Research Fellow – Department of Human Nutrition
Dr Gavin Clark	Director – Research and Enterprise
Dr William Levack	Associate Dean, Postgraduate Office
Dr Anita Dunbier	Senior Lecturer – Biochemistry
Associate Professor James Crowley	Associate Professor – Chemistry
Associate Professor Ben Wooliscroft	Associate Professor, Centre for Sustainability
Dr Katharina Ruckstahl	Senior Research Analyst
AJ Woodhouse	Research Office
John Milnes	Research Office
Marjolein Righarts	Research Office
Eric Lord	Research Office

Massey University

Name	Position
Professor Helen Moewaka Barnes	Professor – Director of Whāriki and Co-director of SHORE
Dr Philip Steer	Senior Lecturer – School of English and Media Studies
Associate Professor Phil Battley	Associate Professor – Institute of Agriculture and Environment
Professor Andrew Shilton	Professor – Environmental Engineering
Dr Gillian Gibb	Post-Doctoral Researcher
Associate Professor Adriane Rini	Associate Professor – School of Humanities
Michael Millin	Research Office
Jo Innes	Research Office
Emma Hughes	Research Office
Kate Arentsen	Research Office

Waikato University

Name	Position
Professor Bernhard Pfahringer	Professor – Computing & Mathematical Science
Dr Hemi Whaanga	Senior Research Fellow – School of Māori and Pacific Development
Dr Charles Lee	Senior Lecturer – Biological Sciences
Professor Juliet Roper	Professor – Professional and Organisational Development Unit
Associate Professor Karin Bryan	Associate Professor – Coastal Marine Group and Earth Sciences
Associate Professor Alistair Steyn-Ross	Associate Professor – Faculty of Science and Engineering
Professor Priya Kurian	Professor – Arts and Social Sciences
Dr Julie Barbour	Senior Lecturer – Linguistics
Mark Craig	Research Office
Carol Robinson	Research Office
Jenny Robertson	Research Office
Bruce Clarkson	DVCR

Crown research institutes

One meeting was held with each of the Crown research institutes.

Institution	Name
AgResearch	Professor Warren McNabb
	Dr Ian Sutherland
	Dr Tony Connor
ESR	Dr Phil Carter
	Professor Bronwyn Davies
	Dr Donia Macartney-Coxson
	Dr Rachel Fleming
	Dr SallyAnn Harbison
	Dr Brent Gilpin
	Dr Liping Pang
	Dr Murray Close
GNS Science	Dr Ian Graham
	Dr Karen Hayes
	Dr Chris Kroger
	Deanne Houghton
	Stephen Bannister
	Dr Martin Reyners
	Dr John Kennedy

	Dr Karyne Rogers
	Dr David Rhoades
Landcare Research	Dr Cynthia Cripps
	Dr David Whitehead
	Dr Ronny Groenteman
	Dr Andrew Eger
	Dr Ilse Breitwiser
	Dr Johannes Laubach
	Dr Janet Wilmshurt
NIWA	Dr Craig Stevens
	Dr Sara Mikaloff-Fletcher
	Dr Vonda Cummings
	Dr Cliff Law
	Dr Natalie Robinson
	Dr Rob Murdoch
Plant and Food Research	Dr Kim Snowden
	Dr Kevin Davies
	Associate Professor Matt Templeton
	Professor Richard Newcomb
	Dr Nick Albert
	Dr Simona Nardozza
Scion	Dr Mathias Solieul
	Dr Stefan Hill
	Dr Ecki Brockerhoff
	Dr Andrew Vogt
	Dr Simeon Smaill
	Dr Martin Bader
	Dr Katharine Challis
	Alison Slade
	Dr Katie Hartnup

Annex 3: Structured interview questions

Background

1. How does the Marsden Fund application, selection and grant management process compare with the processes of other similar research funds, from a researcher's perspective?

Application process

2. How does the time spent on developing proposals compare with other the process for other research funds?
3. What guidance or assistance is provided on developing proposals (eg from your organisation, colleagues, the Marsden Fund or others)?
4. How does the process itself affect proposals (eg the nature of the research, the makeup of the team, the size of the project, the duration of the work, or the panel applied to)?
5. How well does the process cater for changing nature of research (eg big data or new disciplines)?

Selection process

6. Do you think the selection process is appropriate for your discipline?
7. Do you think the peer review and panel processes enable the Fund to select the best proposals?
8. Does the process help to improve unsuccessful proposals for subsequent applications for funding?

Monitoring and evaluation

9. How do the reporting requirements for grants compare with the requirements for other funds?
10. What do you consider to be the benefits of your research, and how have they been reported to the Marsden Fund?

General

11. How does the Marsden Fund support the themes of Vision Mātauranga?
12. Does the process deliver on the Marsden Fund's goals? ("The Marsden Fund invests in investigator-initiated research aimed at generating new knowledge, with long-term benefit to New Zealand. It supports excellent research projects that advance and expand the knowledge base and contributes to the development of people with advanced skills in New Zealand. The Marsden Fund supports research excellence in science, engineering and maths, social sciences and the humanities.")
13. How can the Marsden Fund's investment strategy and management be improved?

Annex 4: Terms of Reference for the Marsden Fund, 2012

The Marsden Fund Terms of Reference (2012)

Nature of the Marsden Fund

1. The Marsden Fund invests in investigator-initiated research aimed at generating new knowledge, with long-term benefit to New Zealand. It supports excellent research projects that advance and expand the knowledge base and contributes to the development of people with advanced skills in New Zealand. The research is not subject to government's socio-economic priorities.
2. The Marsden Fund encourages New Zealand's leading researchers to explore new ideas that may not be funded through other funding streams and fosters creativity and innovation within the research, science and technology system.

Objectives of the Fund

3. The primary objectives of the Marsden Fund are to:
    - enhance the quality of research in New Zealand by creating increased opportunity to undertake excellent investigator-initiated research
    - support the advancement of knowledge in New Zealand, and contribute to the global knowledge base.
4. A secondary objective of the Marsden Fund is to contribute to the development of advanced skills in New Zealand, including support for continuing training of post-doctoral level researchers and support for the establishment of early careers of new and emerging researchers.

Access to the Fund

5. The Marsden Fund is to be operated as a fully contestable fund. Thus proposals for research will be sought and proposals selected and funded on the basis of an open and contestable process.
6. The Marsden Fund is open to applicants that meet the Marsden Fund's eligibility criteria. The eligibility criteria are determined by the Marsden Fund Council. The eligibility criteria must ensure successful proposals are consistent with the nature and objectives of the Marsden Fund stated above, and applicants must be New Zealand-based researchers undertaking research to be carried out in New Zealand or overseas if its nature demands that it be carried out elsewhere. Collaborating researchers from outside New Zealand are able to be included in proposals, but are not able to receive direct funding support for their time or institutional costs.
7. Otherwise, the Council may, from time to time, adjust the eligibility criteria of the Marsden Fund to increase its effectiveness in achieving the Marsden Fund's objectives.

Types of proposals supported

8. Funds will be allocated for the support of research projects, or for the support of individual researchers, including post-doctoral fellows. Funds may also be used to provide

scholarships to support work by post-graduate scholars, but such work should be designed as part of a larger project, that conform to the criteria for the scheme.

9. All proposals funded must be consistent with the nature and objectives of the Marsden Fund and the criteria set out below.

Costing and funding of proposals

10. Full-cost funding of proposals:
    - All Marsden Fund research shall conform to the principles of full-cost funding. Full costing shall include direct costs, associated personnel costs and an appropriate share of overhead costs such as institutional administration and depreciation of research assets, including a share of equipment and buildings.
    - The Marsden Fund Council is responsible for assuring that the methodology by which institutions cost their proposals results in the appropriate share of overhead costs apportioned to the Marsden Fund.
11. Relationship of Marsden Fund proposals to complementary or related funding from other sources:
    - The Marsden Fund Council shall have the discretion to offer to fund, at full cost, a smaller project than the one proposed.
    - The Marsden Fund Council may require applicants to identify complementary and collaborative projects related to their proposal to the Marsden Fund, including the full cost and sources of funding for such projects.

Selection criteria

12. The Marsden Fund Council will develop and publish selection criteria consistent with the nature and objectives of the Marsden Fund. Primary consideration will be given to:
    - the merit of the proposal, including originality, novelty, insight and rigour, and the ability of the researchers to carry out the research
    - the potential of the research to contribute to the advancement of knowledge.
13. Secondary consideration is to be given to ensuring an ongoing supply of top talent through the contribution to the development of research skills in New Zealand, particularly those at the post-doctoral level and emerging researchers.
14. Consideration may then be given to the cost of proposals.

Disbursement of the Marsden Fund

15. The Marsden Fund shall be held in trust by the Royal Society of New Zealand, and shall be disbursed according to these terms of reference. In disbursing the Marsden Fund, the Royal Society of New Zealand is acting as an agent of the Minister of Science and Innovation.
16. Any interest earned on Marsden Fund monies shall be accrued to the Marsden Fund and not used for any other purpose.
17. Advice as to how the funding shall be allocated will be sought from the Marsden Fund Council. The advice of the Marsden Fund Council on funding allocations shall normally be accepted by the Royal Society. The Marsden Fund Council must ensure its recommendations appropriately take into account, and do not exceed, the funding the

Royal Society has received for the Marsden Fund from the Minister plus any interest on that funding.

18. In the event that advice on any funding allocation is not accepted by the Royal Society, the Royal Society shall immediately notify the Minister, in writing, that a disagreement has occurred and the reasons for non-acceptance of the advice. The Royal Society on behalf of the Minister shall then commission a review panel to review the Council's advice. Panel representatives shall include Ministerial, Royal Society and Marsden Fund Council nominee(s). The Royal Society shall seek the Minister's approval of the final review panel and its terms of reference. The Minister shall have the final decision as to its acceptance or not of the review panel's decision to accept or reject the recommendation of the Marsden Fund Council. The results of the review shall be made known to all parties.

Annex 5: Terms of Reference for the Marsden Fund Council, 2012

Marsden Fund Council

Terms of Reference (2012)

1. The Marsden Fund Council exists to oversee the Marsden Fund on behalf of the Minister of Science and Innovation. This Terms of Reference details the role and monitoring of the Marsden Fund Council.

Minister's responsibilities

2. The Minister for Science and Innovation has overall responsibility for the Marsden Fund.
3. The Minister issues a Terms of Reference for the Marsden Fund from time to time, and appoints a Marsden Fund Council to manage the Fund in such a way as to fulfil the objectives as set out in this Terms of Reference and the Marsden Fund Terms of Reference.
4. The Minister has entered into an agreement with the Royal Society of New Zealand to provide executive support to the Marsden Fund.

Functions

5. The functions of the Marsden Fund Council shall be to:
    - oversee the assessment of proposals for funding from the Marsden Fund and recommend to the Royal Society of New Zealand each year those proposals which should be funded and the level of funding to be awarded
    - oversee the progress of research funded by the Marsden Fund by considering the results of monitoring and auditing of contracts undertaken by the Royal Society of New Zealand
    - develop best practice policies and procedures to implement the Terms of Reference for the Marsden Fund
    - provide advice to the Minister of Science and Innovation on the performance and achievement of the Marsden Fund against its objectives
    - Ensure that the relevance and importance of Marsden-funded research is monitored and communicated to the New Zealand public.

Scope of activities

6. In carrying out its functions the Marsden Fund Council shall ensure the following activities are fully addressed, with the support of the secretariat provided by the Royal Society of New Zealand, or other external support as required:

    a. Oversee the assessment of proposals for funding from the Marsden Fund.

    In the funding of proposals the Council undertakes to:

    - develop contestable assessment processes whereby proposals will be treated in a fair, equitable and consistent fashion
    - undertake a peer review process of international standard for all proposals

- maintain best practice procedures in relation to conflict of interest and confidentiality procedures
- issue guidance to the Royal Society of New Zealand on appropriate indirect costs to be included in funding contracts with research organisations.

b. Use principles of best practice to develop operational policies and procedures for the Marsden Fund.

- The policies and procedures used by the Marsden Fund Council in carrying out its functions shall be in accordance with the Terms of Reference for the Marsden Fund, as amended by the Minister of Science and Innovation from time to time. However, such policies and procedures shall specifically exclude any direction from the Minister as to the funding or not of individual proposals.
- The Marsden Fund Council may adopt such additional policies and procedures as it considers necessary to the carrying out of its functions, but those policies and procedures must be consistent with those set down by the Minister.
- The policies and procedures implemented by the Marsden Fund Council shall be published in a Policy Manual and made widely available to applicants and stakeholders. The Marsden Fund Council shall consistently and fairly implement its policies and procedures until or unless variations are similarly made widely known.
- The Marsden Fund Council shall adopt a principle of continuous improvement in its funding processes so that its policies and procedures remain fit for purpose. The Marsden Fund Council shall regularly review its policies and procedures and seek feedback from its stakeholders on the extent that its policies and procedures for administering the Marsden Fund are fit for purpose.

Marsden Fund Council composition, membership and relationship with the Royal Society of New Zealand

Membership

7. The Marsden Fund Council consists of up to 11 members, comprising a Chair and 10 eminent researchers spanning the range of disciplines. The Marsden Fund Council shall meet as required, but a minimum of twice a year to discuss recommendations by expert panels on preliminary and full proposals.

8. The Chair and members of the Marsden Fund Council shall be appointed by the Minister of Science and Innovation, with individual members appointed for terms and under such conditions as determined by the Minister from time to time. In making appointments and setting terms and conditions of membership, the Minister shall seek the advice of the Royal Society of New Zealand, existing members of the Marsden Fund Council and others in the research community. A Deputy Chair may be appointed from within the Council membership by the Council members.

Liability of members

9. The Marsden Fund Council members will not be personally liable for acts or defaults done or omitted in good faith in the exercise or intended exercise of their functions under these terms of reference.

Executive support for the Marsden Fund Council

10. Executive support for the Marsden Fund Council shall be provided by the Royal Society of New Zealand, pursuant to an output agreement negotiated between the Minister and the Royal Society of New Zealand. The output agreement will specify both the range of services to be provided and the price for those services. Of the funding provided for administration, an amount shall be identified as being for the purpose of meeting the expenses of the Council.

Provision of secretariat services

11. The Marsden Fund Council shall be entitled to require services from the Royal Society of New Zealand in accordance with a Memorandum of Understanding between the Royal Society of New Zealand and the Marsden Fund Council. The Memorandum of Understanding will outline the roles and responsibilities of the two parties.
12. The Marsden Fund Council shall communicate directly with a nominated employee of the Royal Society of New Zealand whose function is to manage the executive support for the Marsden Fund Council.

Advice to the Minister

13. The Marsden Fund Council is to provide the Minister of Science and Innovation with a biennial progress and achievements report for the Marsden Fund. The report is to be prepared by the Royal Society of New Zealand, under the direction of the Marsden Fund Council, according to the requirements outlined in the Memorandum of Understanding and agreed with the Minister.

Management and dispersal of funds

Funding for allocation

14. Funds available for allocation each year shall be formally advised to the Royal Society of New Zealand and the Marsden Fund Council by the Minister of Science and Innovation subsequent to the presentation to Parliament of the Estimates of Appropriations for that year, and no irrevocable contracted commitments should be made prior to that advice being received. However, guidelines as to the likely level of funding shall be advised to the Royal Society of New Zealand and the Marsden Fund Council by the Minister of Science and Innovation from time to time, to assist the smooth running of the Marsden Fund.

Advice on Marsden Fund allocations

15. Advice as to how the funding shall be allocated will be sought from the Marsden Fund Council. The advice of the Marsden Fund Council on funding allocations shall normally be accepted by the Royal Society of New Zealand. The Marsden Fund Council must ensure its recommendations appropriately take into account, and do not exceed, the funding the Royal Society of New Zealand has received for the Marsden Fund from the Minister plus any interest on that funding.
16. In the event that advice on any funding allocation is not accepted by the Royal Society of New Zealand, the Royal Society of New Zealand shall immediately notify the Minister, in writing, that a disagreement has occurred and the reasons for non-acceptance of the advice. The Royal Society of New Zealand on behalf of the Minister shall then commission a review panel to review the Marsden Fund Council's advice. Panel representatives shall

include Ministerial, Royal Society of New Zealand and Marsden Fund Council nominee(s). The Royal Society of New Zealand shall seek the Minister's approval of the final review panel and its terms of reference. The Minister shall have the final decision as to its acceptance or not of the review panel's decision to accept or reject the recommendation of the Marsden Fund Council. The results of the review shall be made known to all parties.

Monitoring of the Marsden Fund Council

17. The Ministry of Business, Innovation and Employment shall monitor the effectiveness and efficiency of the management of the Marsden Fund. This will include monitoring the effectiveness of the implementation of the Terms of Reference for the Marsden Fund and the suitability of the Memorandum of Understanding between the Royal Society of New Zealand and the Marsden Fund Council to achieve the Fund's objectives.
18. The Royal Society of New Zealand and the Marsden Fund Council will make provision for the collection of financial information and other data in support of performance metrics for the Marsden Fund required by the Ministry of Business, Innovation and Employment in carrying out its monitoring role.